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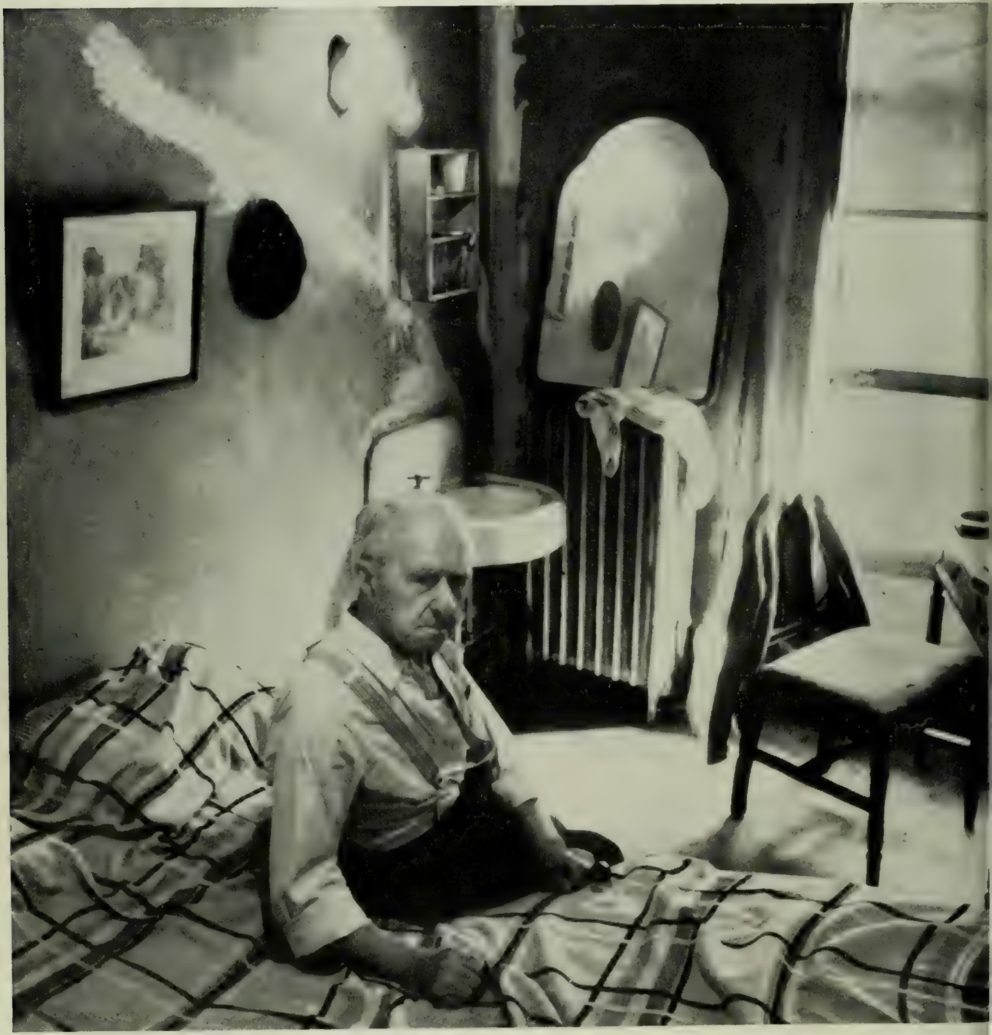

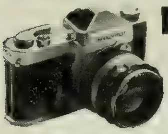

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Authors

Twenty-three-year-old **Mark Terry** is presently teaching high school biology in Portland, Oregon. He received his bachelor's degree in anthropology from the University of Washington in 1969 and completed a one-year master of arts in teaching program in science education at Cornell University. Terry has taught evolutionary anthropology and human ecology to summer school students in Central Los Angeles and has also worked with elementary school children from the Pomona barrio. He was a speaker at the John Muir Institute conference at Aspen, Colorado, in September, 1969. Terry hopes someday to start a school based upon his personal convictions.

Nicholas T. Mirov was born in Siberia in 1893, received a B.S. degree from the Imperial Institute of Forestry in St. Petersburg, Russia, in 1916 and then came to the United States to live and pursue his studies. He received an M.S. degree in forestry in 1931 and his Ph.D. in plant physiology from the University of California at Berkeley. A long association with the U.S. Forestry Service followed his first position as an assistant silviculturist with that agency. Specializing in the biochemistry of terpenes and the physiology of forest trees, he has studied pine trees all of his life. The author of several books and articles on the subject of pines, Mirov is now a lifetime research associate in the Department of Geography at the University of California at Berkeley.

Because he plans to make several future trips to the far north and can work better anonymously, the Canadian author of "From the World of Tomasik Nutarareak" uses the pen name of **Bob Skovbo.** A native of Latvia, he studied at the University of Manitoba in Winnipeg and at Carleton University in Ottawa. After working as a lab technician in virology for several years, Skovbo went to the Northwest Territories in 1965 to work for a mining exploration company. The country proved so magnificent, he returned the following year to travel and observe—and has been doing so ever since. He is the author of "Northwest Passage," which appeared in the June-July, 1970, issue of NATURAL HISTORY.

Photographer **Paul von Baic** was born in Yugoslavia and studie photography at the Vienna Scho of Arts in Austria. He settled Canada in 1960 after having tra eled and worked extensively in E rope. Von Baich, whose phot graphs also illustrated "Northwe Passage," has been the camerama for several Canadian documenta films.

Born in Cleveland, Ohio, **Sco McVay** is currently an admin trator at Princeton Universi where he received a bachelor's gree in 1955. Actively interested whales and their habits for mo than a decade, he has led efforts both this country and Japan to p vent further ravaging of the gre whale stocks by the whaling ind try and is presently serving as t chairman of the Committee Whales of the Environmental I fense Fund. McVay, who has st ied the behavior of the bottlen dolphin in Florida, is currently te ing whether porpoises can comn nicate abstract information, a plans future studies of the soun and behavior of a variety of tacea.

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Author of numerous books and magazine articles on nature and related subjects, **Jean Craighead George** received her B.A. from Pennsylvania State University in 1941, and was honored by that institution as Woman of the Year for 1968. Her book *My Side of the Mountain*, coauthored with her husband, John, was recently made into a movie, and three of her volumes are on the American Library Association Notable Book List. George paints, illustrates, and "raises everything from one-celled animals to children." Her latest book, *Beastly Inventions*, from which "Diners of Unlimited Diversity" is adapted, will be published by the David McKay Company this month.

Professor of communication design at Ohio State University, **Fred A. Zimmer** was born in Pataskala, Ohio. After earning a B.F.A. degree from Ohio State in 1948, he did graduate work in graphic design at Pratt Institute. In 1966-67, he went to India on a Fulbright grant to study the ways in which a primarily preliterate society, such as rural India, uses pictorial and other nonverbal forms for mass communication. Zimmer has also studied the sign-symbol systems of such diverse areas as Greece, Turkey, Japan, Mexico, and western Europe. His drawings, articles, and photographs have appeared in many national publications, including *Harper's* and *Esquire*.

A native of Cincinnati, Ohio **Corson Hirschfeld** is a profe sional photographer and free-lan writer who has traveled to Keny North Africa, Haiti, Surinam, Mar tinique, and Guadeloupe on phot graphic assignments. He is a fo mer editor of the *Journal Herpetology* and was instrument in the formation of the Society f the Study of Amphibians and Re tiles. Hirschfeld is also a form chairman of the Ohio Herpetol gical Society and an amate astronomer, spelunker, and co petition swimmer.

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Throughout the history of this country we have taught ourselves the magic principles of a wonderland environment; we have applied those principles with an unmatched faith in their accuracy; and we have commended them to our own future generations and to the peoples of the world. Lately, we have discovered our principles belong only to our imaginations and not to the environment.

Perhaps an example from my own education will show how easily and successfully dubious environmental lessons are taught in classrooms every day. I attended an elementary school just outside Seattle, Washington, during the early fifties. In those days I was convinced that the way to train for space flight was by writing and illustrating my own science fiction. I wrote stories and drew rockets at a furious rate, aiming them all at the desks of my early teachers. Somehow those good people managed to read them all and return them with glowing words of encouragement, knowing full well this meant longer stories and more rockets. Their stamina in facing these reams of pulp fiction, and even more, their success in teaching me the values of imagination and expression command my respect. But these same good teachers were also successfully teaching lessons about the environment that have endured for years.

Innocently, through their own ignorance and misinformation, my teachers taught me that paper would always be in infinite supply. Never was I asked to conserve and reuse my discarded mistakes or to use both sides of a page for a finished story. Never did I have to tolerate a lack of paper. The magic stacks of newsprint were never allowed to disappear from the shelves of the classrooms. This seemingly unlimited supply was the most effective of the lessons about paper, but supporting information filled in the environmental picture and left me little room for doubt.

We were taught that our state, Washington, "produced" paper at a rate exceeded only by Oregon, our friendly rival to the south. And if both states produced so much, even competing to outproduce each other, it was clear our classroom would never have to worry about its supply. We knew paper was made in pulp mills, because we were occasionally plagued by the "funny" smoke from the mills in Everett or Tacoma. And we were told the paper came from trees.

I could see that paper came from trees when I looked closely at our newsprint. In each sheet there were little flecks and fibers that looked like wood, and the teacher said they were. But knowing that paper was produced by men in nearby towns, I came to the easiest conclusion: trees gave us paper as cows gave us milk. I knew the trees were cut, but that seemed the least important part of the process.

So I, and all my classmates, learned these three lessons: (1) there will always be paper, (2) paper comes from trees, (3) men produce paper. In these lessons lies an environmental education upon which a nation has been bui Never were we asked to consid any of the contradictions and pa doxes implicit in the three "truths

I learned something nearer t truth about paper and trees from bit of environment near the mou of the Columbia River known Long Island. I owe my introducti to the island to a teacher, but was wiser than most. He mere showed us how to canoe out to t island.

Long Island forms part of a lar wildlife refuge in a hundred-squar mile shallow bay on the Washin ton coast. The north-facing bas cliffs—camouflaged in mosses a ferns, darkened by shadows fro great overhanging trees, and o structed by fallen trunks that cou not hold—were in no way made f man. I have never seen or heard dinosaur on the island, but scra bling for footholds along the base the northern wall I am never su that they are not eyeing me fro above. In the interior, the wetnes the size of the ferns, and the nu ber of insects date the island to t coal-forming forests of the Carbo iferous era. But to any reader Tolkien, the island can be nothi other than the home of the Ents, t trees towering in their wisdom.

Long Island was logged onc and most of the forest is seco growth. Some of the virgin cedar however, were left. There is nothi to prepare one for their size. See through the younger firs and c dars, one of these elders appea first as an illusion, perhaps a sta of lesser trunks that has not y

Teaching for Survival, by Mark Terry. Copyright © 1971 by Ballantine Books, In

“We cannot afford to continue teaching the myth of simple cause and effect. We and our students must develop the awareness of causal webs...”

by Mark Terry

ne into focus. When the reality
the single trunk is finally unde-
ble, one simply stops. There is
casually passing by such age
l power.

Overtowering the young forest,
eral of the virgin cedars had
wn lightning and were hollowed
l blackened inside, their outer
rk untouched by the flames. If I
re to tell how the lightning left
m eyes and upraised arms, look-
out over the island and the bay,
would not believe me. Yet they
e such heads, they do oversee
bay, and who am I to say they
not move slowly like the Ents?
Some of these gutted cedars have
ome the spacious quarters of lo-
bears. Living in such elegance
bears are clearly feudal lords of
island's animals.

Signs of the first loggers of-
ded us in the form of roads
ned to swamps and of impossible
dergrowth that follows sloppy
ging. But the new forest, under
tutelage of the great cedars,
peared to have a strong hold, and
thought the island had been leg-
ted into safety. I was impressed
the wisdom of my fellowmen,
o had instituted a wildlife ref-
e, had outlawed all but bow and
ow hunting, and had not rushed
provide easy access across the
y. I tried to imagine what my
ildren's children might find when
forest was that much older, and
resolved to leave instructions for
em to return.

I did not have to worry long how
leave such instructions. Soon af-
the island and I became acquainted, I began to see how paper and lumber are produced: the second growth is disappearing from the south end, new logging roads are following the surveyor's red flags across the island. My children's children are not likely to find anything approaching the Long Island I have known—perhaps they will find instead the efficient, calculated growth of a tree farm.

I have seen, now, how paper comes from trees: a living forest is killed; the soil it held loses its natural fertility and erodes; once-clear streams are filled with sediment; the animals and plants dependent on the forest are forced into neighboring forests, if there are neighboring forests; and in a short season of logging, the members of the forest community are shown the folly of their existence. And, of course, never can the trees be allowed to grow to the irrelevant and useless size of the virgin cedars.

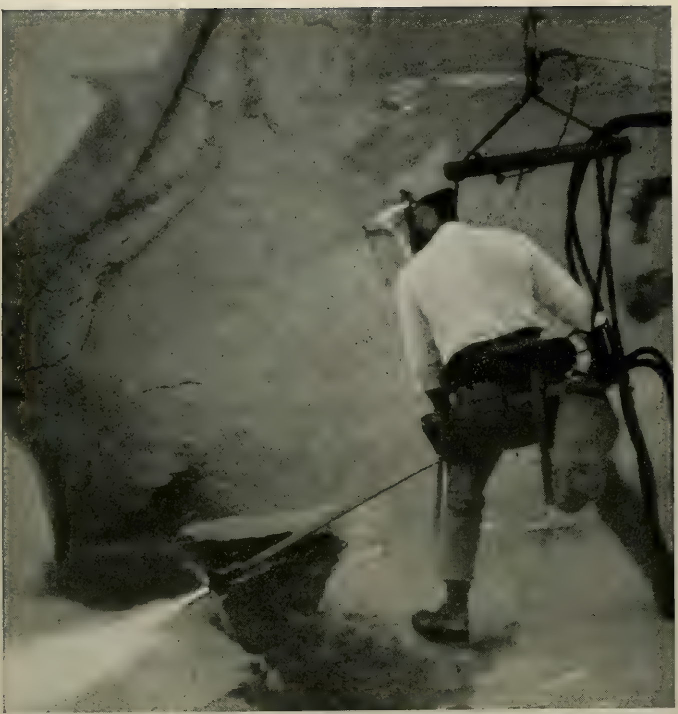
In this manner was my newsprint produced, in this manner it came from trees. And only if the soil is artificially maintained and forest communities are never allowed to mature, never allowed to support the animals they could, never allowed to reach the size they could; only under these conditions of environmental strife is there anything like an infinite supply. I still have trouble comprehending the environmental cost of newsprint, but I have learned, at least, that it is anything but cheap.

I have begun to approach environmental problems according to my own incomplete understanding of the world. Every teacher should begin building a similar, hopefully better and more complete, world view. My own investigation has led me to categorize environmental problems under two headings: Overuse and Overgrowth.

Knowing that Earth's energy is rationed and distributed through a complex web to the variety of living organisms, knowing that land area is limited and that important minerals are scarce, man must understand that the maintenance of basic subsistence for his present billions is already putting an unbalancing strain on a finely tuned system. Many animals that have comparable energy and material requirements have already been eliminated or seriously reduced by man's presence: major groups of whales and larger fish; major ungulates such as the bison; the predators whose competition has been feared beyond reason, such as the mountain lion; and our fellow large primates—the chimpanzees, gorillas, and, in particular, the orangutans—whose delicate habitats have been usurped for humans.

If we had not decimated other life forms, our achievement of current population size would never have been possible. We hold our species at this unprecedented size only at great expense to the rest of life (and to ourselves).

On the criterion of maintaining sheer subsistence alone, there are probably too many of us now. Of course, man does not live at the subsistence level. Perhaps a third of



Another of those "impossible" views with a Questar

At historic Stone Mountain near Atlanta, a carver works on the Confederate Memorial. (See covering shot below taken with 50mm. camera lens, showing Questar Field Model mounted on Linhof tripod, Topcon camera attached, and worker indicated by black arrow.) The Questar photo, above, on Tri-X, 1/60 second, shows him in constant motion as he swings from a harness on the sheer granite wall, guiding himself with his feet and vibrating with the thrust of his powerful thermo jet torch. The photoengraving process permitting, you will notice such detail as his belt loops and a band around his left ankle. Photographs by Mr. and Mrs. Ralph Davis of Sarasota.

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mankind far exceeds the near subsistence level at which his fellows live.

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The extension of our reach so far beyond what we actually need has had a number of consequences: As we near the limits of Earth's resources, the likelihood that the poor of the world will ever share in the wealth to which they aspire becomes less and less. As we render carbon compounds into nearly indestructible plastics, the likelihood that we can maintain the carbon cycle on which all our food is dependent becomes less and less. As we render previously normal elements radioactive, it becomes less likely that any life forms can escape radiation poisoning and mutation.

Already we have begun stepping on our own toes, as is inevitable in the feedback web of the environment. Our present level of agriculture is dependent on both agricultural and transportation machinery. In order to feed ourselves at present levels, we are consuming far more than food: we are also consuming energy reserves to cultivate and distribute that food. Though it may take fewer farmers to produce an equivalent amount of food, it takes even more energy from fuel than it did originally. Our present quality of agriculture is also dependent upon artificial fertilizers.

The rates at which we are producing changes on Earth—through formation of useless pollutants, toxic pollutants, through domestication of food animals and crops, through extermination of competitor animals and crops, through alteration of land occupancy and use—are unprecedented in the observable geologic history of the planet. We can be sure that man is the single most

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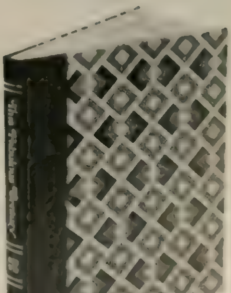

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effective environmental force, a least since the last glaciation. Rates of change, when normal populations are merely operating at subsistence levels, generally tend to be moderate, slow enough that the entire life web is constantly in a state of gradual adjustment and balance. Unfortunately, it takes industrial know-how to make temporary adjustments to industrial exploitation, and the other organisms have never learned the industrial way of life.

Lest we lose ourselves in the problem and become typically overwhelmed into a state of renewe negligence, allow me this digression into overuse.

My typewriter consists of man plastic parts, the keys for instanc and the roller knobs. Here, then, i a collection of carbon extracte from the normal carbon cycle tha is essential to plant and animal life These plastic compounds will probably end up in the atmosphere wit the destruction of the typewriter And, as records are now beginnin to show, the plastics are likely t end their atmospheric existence b entering the fat tissues of animals and then the tissues of whoever eat the animals, and so on. Useless, potentially hazardous to the lives o the animals they will enter, thes compounds did not exist until a fe years ago.

The paper here also comes courtesy of the carbon cycle, but it i not such a permanent sink for th good element. It will probably fin its way into the atmosphere in useful form and may eventuall find its way to the formation of another tree. But this raises anothe question: how long will it take? I the years that the cut forest remain bare, the richness of the soil declines and the soil itself erodes to dangerous degree. By writing thes pages I am challenging the forest t a bit of an unfair race: asking it t restore itself while temporarily impounding the resources needed fo its restoration, hoping the fores grows back, but hoping to keep th paper just the same.

There is some loose change her on my table. By their ring and b the color of their edges I can se that the dimes and quarters are no sandwiched with copper, making u for missing silver. Having pulle

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the silver from the hills, we begin to pull the copper. But I know where we now have to go for the copper. We plan to gouge out the North Cascades and other wild areas. I recall the copper shortage of a few years back.

Plastics, paper, copper. I have great quantities of these substances right here before me. I seldom give them a first, let alone a second, thought. In my mind I have a typewriter, paper, and some change. In reality, I have a toxic supply of formerly beneficial carbon. I have the heart of a stand of trees, possibly capable of restoring itself in my lifetime, but probably incapable of restoring the full community of plants and animals it used to support. And I have the ripped side of a mountain, ripped in order to give me a means of barter and exchange, once ripped and never to be restored.

Holding to the fiction that man is a species remaining at a population of three and a half billion, we find that our problems are still more complex than we have so far described. We force an even greater imbalance on the web. Our rates of consumption, which we persist in calling production, are not constant. As if they were not already exerting a runaway force on the world, they increase by a few percent per capita annually.

The increase in consumption, in standard of living, in gross production, occurs primarily in the already developed countries. That this increase still measures as a per capita increase throughout the world's population only shows the extent to which developed countries control the world's resources. A statistical mean can show more goods and services flowing to the starving nations, along with the affluent nations, each year; in reality, the flow is almost completely diverted to the affluent.

An animal's rate of metabolism, hence his consumption of materials and energy, varies from birth to death and from season to season. Human metabolic rates peak during the infant growth spurt and then the adolescent growth spurt. But our economy is based on the constant growth in consumption.

I have passed through adolescence, most of my energy-con-

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e got to have clothes to wear to take
ntage of it. A winter coat, shoes, and
s cost money. Money Linda's parents
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suming growth is done. Yet I certainly consume more materials and energy now than I did a few years ago: I own a car, rent a house with heating and plumbing, run electrical appliances and lights, read more printed matter, all in excess of somewhat lesser demands a few years ago. The contrast is even greater if I compare my own consumption with that of my father at an equivalent age. And both of us, regardless of our ages, are beset by incessant pleas to buy and use even more: I am told I should turn this typewriter in for an electric, turn my five-year-old car in for a new model, get a machine to do the dishes, get an air conditioner to cool my house.

It is safe, I think, to say that had the rest of the animal world operated on such a consumption-growth philosophy, there would never have been room for the merest beginnings of human evolution. Our own practice of this philosophy has already caused the termination of thousands of evolutionary paths, one for every species extinct at the hand of man. In fact, there could be no more telling sign than these extinctions: the rate of extinctions goes up with every year, quite in keeping with the increase in man's standard of living.

Cutting back on man's exploitation, finding better ways to use and to reuse the resources we have, these are measures necessary to reduce the man-caused environmental imbalance. These measures are also necessary within our own schools and classrooms to give meaning to any attempts we may make to offer our students an environmental education. Only if educators are demonstrably involved in finding and carrying out solutions, will they have a reasonable chance of achieving the following objectives of environmental education:

The ability to perceive and to conceive of nonlinear causal relationships: We must leave Aristotle behind. We cannot afford to continue teaching the myth of simple cause and effect. We and our students must develop the awareness of causal webs operating in all areas of our environment. We must develop the vocabulary necessary to describe such causal webs. We must develop predictive abilities through

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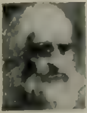

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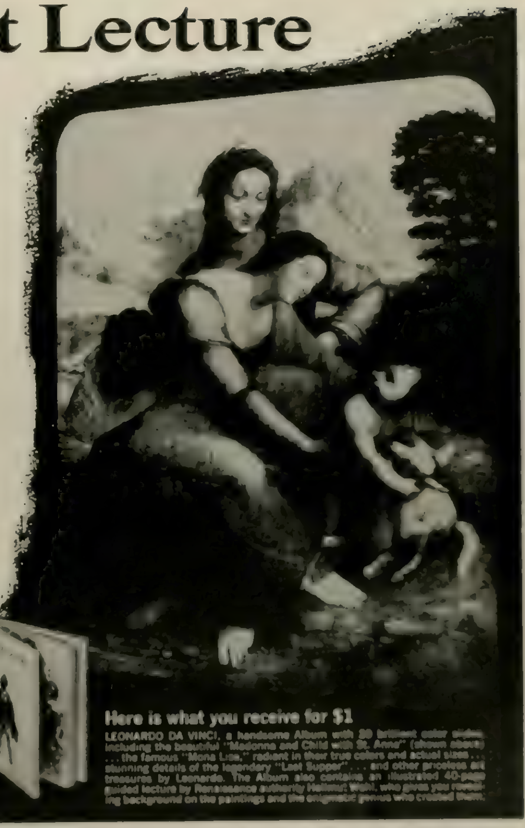

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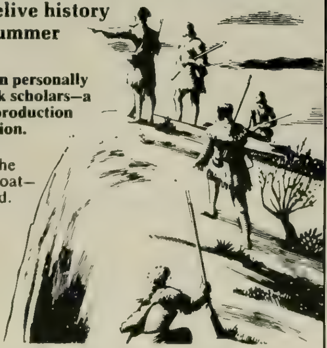

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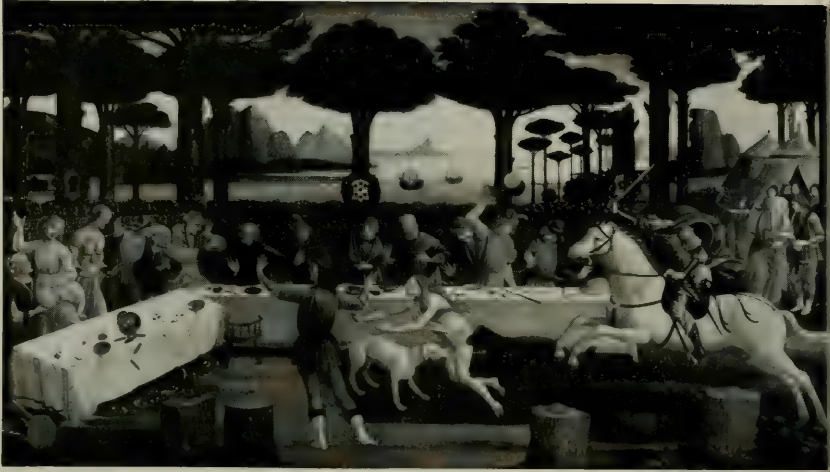


Botticelli: Wedding chest of Lucrezia di Binni, Third Pan

The Pines of Ravenna

A doomed and haunted forest outside an ancient Roman city has inspired painters and poets for centuries

by Nicholas T. Mirov

The eighth story related on the fifth day of Boccaccio's *Decameron* concerns Nastagio degli Onesti, a wealthy man of the ancient city of Ravenna, who was in love with the daughter of Messèr Paolo Traversaro, a prominent citizen of the same city. The daughter, more nobly born than her suitor, cruelly rejected him, and in an attempt to forget her, Nastagio retired to a nearby pine forest.

On one Friday afternoon at about four o'clock, Nastagio, lost in thought, was wandering aimlessly through the Pines of Ravenna when his reverie was broken by loud cries and the startling appearance of a naked woman pursued by two mastiffs and a swarthy knight, sword in hand, astride a black horse. As this strange group approached, Nastagio picked up a pine branch to defend the poor woman, but before he was able to act, the mysterious horseman paused and addressed him, saying:

> Nastagio, you were but a child while I lived. My name was Messèr Guido degli Anastagi, and I loved a young woman as much as you now love Traversaro's daughter. She spurned my love, and because of that I killed myself with this very sword. For the sin of suicide I was eternally damned. The girl I loved died shortly after, and for her cruelty to me, she, too, was sent to hell. It is our punishment that she must run from me and I must kill her with my sword, tear from her body that hard, cold heart which neither love nor pity could ever enter, and toss it to these dogs to devour. Once this is done, she must recover instantly and run from me again, only to be overtaken and slain once more. We are damned to this for as many years as there were months that she was cruel to me. We appear here in this same place every Friday afternoon.

The apparition greatly shook Nastagio. But afterward he realized that he might use Guido's terrible punishment for his own ends Consequently, he invited the entir Traversaro family and many o their friends to the pine forest for banquet on the following Friday afternoon. The invitation was dul accepted, and Nastagio ordere trees cut to make a clearing for th tables in the exact spot where h had witnessed the spectral murder

The guests arrived and sat dow to the feast. Just as the last cours was being served, the shriekin woman, pursued by the dogs an the knight on horseback, appeare in front of the tables, and th dreadful punishment was re-enacte before the diners.

When the woman and the knigh disappeared again into the forest all who had witnessed the scene discussed the crime and its punishment. At length, Nastagio's beloved fearing a similar punishment fo her own cruelty, sent him word tha she had repented. She and Nastagi arried and lived happily together r many years.

The pine forest of the Boccaccio ory is La Pineta di Ravenna. This rest is composed mostly of *Pinus* *nea*, which the Italians commonly ll *pino domestico* or *pino da pi- oli*. In English, the tree is known the Italian stone pine because of s hard seeds, or *pinoli*. The rench call the tree *pin de parasol* ecause of its umbrellalike shape, a semblance that is enhanced when e lower branches are cut for fuel. his is the typical shape of the tree the Italian landscape. Only in arks and on private estates, where e trees are protected against oachers in quest of firewood, can is pine be seen in its natural form hen its umbrella crown is less con- picuous.

The first written account of the ines of Ravenna goes back to A.D. 76 when it was recorded that aulus, a brother of the Roman eneral Orestes, was killed by the ermanic chieftain Odoacer in a lace near Ravenna "qui dicitur inetum." Fourteen years later, heodoric, king of the Ostrogoths, amped in these same woods and rom them besieged Odoacer's rmy, which was shut up in Ra- enna. After three years of fighting, doacer surrendered. Theodoric in- ited him to dinner and murdered im.

Boccaccio might have chosen the ines of Ravenna for the setting of is tale of Nastagio because of his dmiration of Dante. In Canto 28 f *Purgatory*, Dante compared this forest to the earthly paradise. Dante had spent the last years of his exile from Florence in Ravenna. He finished the *Divine Comedy* in Ravenna and died there in 1321 when Boccaccio, his future biographer and adoring critic, was eight years old.

The names Boccaccio chose for his tale have historical significance. The Traversaros were well-known Ravennese Guelphs. The family name of Guido degli Anastagi is mentioned often in the history of Ravenna, and the degli Onestis were Ravennese aristocrats.

In 1483, more than a hundred years after the *Decameron* was written, a marriage took place in Florence between Gianozzo Pucci and Lucrezia di Binni. The painter Botticelli was commissioned to decorate the four panels of Lucrezia's wedding chest. The theme, suggested by the groom's father, was the story of Nastagio degli Onesti in the Pines of Ravenna.

Three of the original panels, which measure approximately 33 by 55 inches, depict scenes from the pine forest. They are in Madrid's Prado. The fourth, showing the wedding feast, was sold for $250.000 at auction in London in 1967.

Botticelli apparently designed the panels himself, for they have the characteristic charm of the great master. Surely he supervised their execution, since the work was done in his own workshop. The late art historian Bernard Berenson concluded that the actual painting was done by two of Botticelli's assistants, Jacopo del Sellajo and Bartolomeo di Giovanni. Here and there in the three panels, however, we can recognize Botticelli's own hand, particularly in the scene of the feast in the pine forest, which is far superior to the other two.

On the three panels, Botticelli depicts seven of the scenes that occurred in the forest. The first panel contains three scenes. At the extreme left, Nastagio, dressed in a blue jacket and red tights, talks with his friends in front of a gaily colored tent. In the next scene, he stands between two trees, head down, apparently deep in thought. The largest scene of the first panel shows the naked girl attacked by the two mastiffs, and behind them the knight clothed in a flowing red cape. Sword in hand and poised for the kill, he sits astride a white charger. Because of the dark pines of the background, Botticelli has substituted a knight in gilded armor and a white horse for Boccaccio's dark rider on a black horse.

In the foreground of the second panel the knight completes the ritual slaying, and the dogs devour the girl's heart. Nastagio, having thrown away his pine branch, watches from the side. In the background the ordeal is repeated.

The third panel shows the feast in the pine forest. Nastagio explains to the guests the significance of what has happened. On the extreme right, an intermediary, the girl's nurse, conveys to him the message that her mistress has repented her past behavior. Nastagio, listening attentively, appears happy.

The first of Botticelli's panels shows evidence of poaching in the Pines of Ravenna. Some of the trees have been cut carelessly. Limbs are broken, and branches and pieces of trunks scattered over the ground. At the same time, the painting strives to show that the personal drama of Nastagio has not interfered with the orderly course of life. Deer graze peacefully, and rabbits are visible under the trees. In the background, ships carry on the everyday business of commerce.

In the second panel, where the dramatic effect is at its height, things have changed. The rabbits have fled; a deer at a watering trough turns its head in alarm. The forest is different. The bark of the trees has changed, suggesting the hand of a different artist, and the ground is as smooth as a polished floor, the trees standing on it like so many cylinders, indicating that whoever painted it was unfamiliar with a real forest.

Greater care is given to the rendering of the forest in the third panel, where Botticelli's hand is most clearly seen. An exquisite screen decorated with pine branches and cones protects the guests from the sea breezes. The Medici coat-of-arms adorns the pine trunks. The trees have been cut, not by hurried poachers, but by skillful woodsmen. The stumps are smooth, the splinters left standing realistically in the center. A balance between man, art, and nature has been restored.

Dante's description of the forest, Boccaccio's tale, and the Botticelli panels have made the pine forest of Ravenna famous; its history and significance have not been lost on later generations of poets and writers, including many who wrote in English.

In 1509, Christopher Tye wrote a poem called, "A notable history of Nastagio and Traversari no less pitifull than pleasant." A hundred and fifty years later Dryden translated Boccaccio's prose into ballad form, changing Nastagio's name to Theodore and calling Traversaro's daughter, nameless in the *Decameron*, Honoria.

Byron spent two turbulent years in Ravenna. It was there that he wrote *Don Juan* in which he described how "in the sweet hours of twilight" he rode through the "evergreen pine forest" thinking of its past "and of the spectre huntsman and his hell-dogs." Shelley, Byron's guest at Ravenna, wrote to his wife, Mary, in 1821 to tell her how he and Byron rode "in the evenings through the pine forests which divide the city from the sea." Eleven months later, he drowned at sea and Byron left for Greece, where he died two years later.

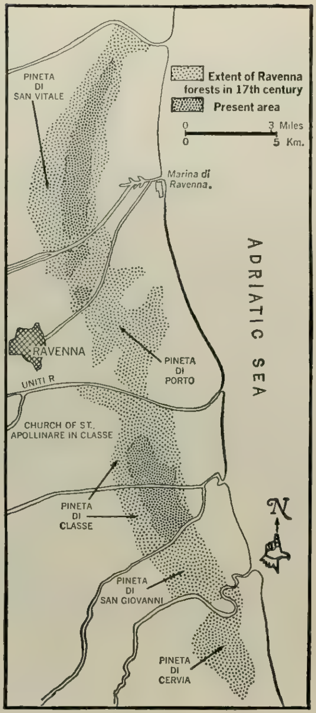
In his *Italian Hours*, Henry James describes his visit to Ravenna in 1869:

> I drove out to [the pineta] for Byron's sake, and Dante's, and Boccaccio's, all of whom have interwoven it with their fictions . . . . [I] rambled for an hour in the woods of Associations, between tall smooth, silvery stems of pines and beside the creek which led me to the outer edge of the wood and a view of white sails, gleaming and gliding behind the sand-hills. As the trees stand at wide intervals and bear aloft in the blue air but a little parasol of foliage, I suppose that of a glaring summer day the forest itself was only the more characteristic of its clime and country for being perfectly shadowless.

In 1965, on the occasion of the 700th anniversary of Dante's birth, Prof. Pietro Zangheri published a well-documented monograph, "La Pineta di Ravenna." According to Zangheri, in prehistoric times the whole of the Adriatic coast from the Po Valley south to the area around Ravenna was covered with a somber broadleaf forest of oak and beech, some other minor tree species, and a dense undergrowth of hazelnut and other shrubs. In the openings and forest glades, the ground was lush with herbaceous vegetation.

Oak, from which Roman ships were built, was once so plentiful there that the Emperor Augustus built a naval base near Ravenna. Roman writers, Titus Livius among them, always referred to this particular forest as a *silva*, a "broadleaf forest," and never as a *pinetum*, a "pine grove."

Soon after the time of Augustus, however, sea currents deposited so much sand along the coast that the Roman harbor became heavily silted and had to be abandoned. Later the harbor was razed to the ground, and the causeway connecting it with Ravenna was destroyed by the Longabards. The once bustling port was slowly buried under the sand.



Partially for esthetic reasons and partially for the production of pine nuts, *Pinus pinea*, a species of pine native to the warm Mediterranean shores of Italy, was introduced to the vicinity of Ravenna by monks during the fourth and fifth centuries A.D. Because of the rising temperatures and improved climate of that period, the trees thrived.

Pines are pioneer invaders. Throughout their history, from their Mesozoic origin, they have stood ready to occupy any barren area. Soon the pines escaped from the plantations of the monks and established themselves on the sand hills that lay between the *selva*, or "forest," and the receding sea. Gradually, they formed groves—*pinete*—along the coast, and penetrated the edges of the *selva*, forming a mixed oak and pine forest. Dr. Zangheri believes that this forest, with its "harmonious mixture" of broadleaf trees and pines, wa the one that Dante knew and described in *Purgatory*.

Since Dante's time, the broadlea trees have been cut, and lately th pines themselves have fared poorly The climate of the Adriatic coas has deteriorated markedly. Recurrent cold spells have damaged th frost-tender *pinoli* pines, leavin the weakened trees vulnerable to insect attack. The population of Romagna has expanded, and the settlers have either burned larg numbers of pines or chopped them down to clear land for habitation cultivation, and industrial development.

Some areas of the Pines of Ravenna, which once extended in a twenty-five mile band along the Adriatic, no longer exist. These include the Pineta di Porto, east o Ravenna, which had been completely destroyed by 1800. Other groves—San Vitale, San Giovanni and Cervia—disappeared shortly after. The Pineta di Classe, site of an ancient port south of Ravenna, i greatly reduced. The church o St. Appollinare in Classe, buil about A.D. 545 in the center of the port city near the harbor, now stands four or five miles from the sea, alone and divested of the forest that once surrounded it.

The gradual disappearance of the ailing pine groves has aroused alarm. Professor Zangheri's monograph was intended to stimulate interest in saving them. While this is no easy task, some conservation measures could be implemented. The forest could be protected from trespassers, broadleaf trees might well be reintroduced into it, or the area might be reforested with a more frost-resistant species of pine.

Ravenna the city, with its old churches, Byzantine mosaics, and looted sarcophagi, will continue to attract tourists as well as poets, but the Pines of Ravenna, the Ravenna of Dante, Boccaccio, and Botticelli, of Byron and Shelley, with its wealth of history and deep significance for the human condition, will never regain its glory. The pinoli pines will linger for some time, to be gradually replaced by the more northern *Pinus pinaster*, a newcomer to the Adriatic coast of Italy.

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mp gymnast springs high into the air during exercise that displays the use of only a few of his 600 odd muscles.

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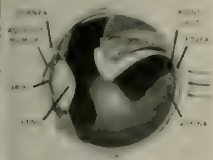

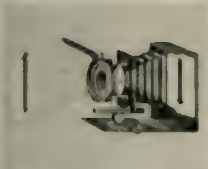

The eye is a natural [illegible] camera [illegible] shifting [illegible] from one distance to another by changing the curvature of its delicate lens.

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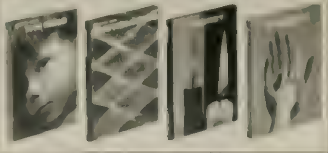

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From the World of Tomasik Nutarareak

Beyond the tree line on dog sled, a photographer encounters the elusive aura of the Arctic

by Bob Skovbo

photographs by Paul von Baich

To the man who has never ventured very far beyond the tree line—and then made sure to stay well within the driftwood belt—the treeless Arctic still retains the elusive aura of the Beyond. He has stood at its edge; not a fixed border, but the mobile edge of sight, receding from ridge to ridge as each is reached and becomes a lookout into the next perspective—one step closer to that mythical land. Somewhere along that boundless limit, he turned back. With the distinct feeling that just there, to the far side of that last skyline, it began. What? The Beyond, the land without limit. The true Arctic.

The man who was there is apt to be more matter of fact. To him it is a place, not a nameless vision; a known face, not a phantom. He may know only a small segment of its span. But to have been there, to have traveled toward this bay or promontory, to have stopped for shelter at the foot of that cliff, or merely in the scant lee of the upturned *komatik* ("sleigh") on some featureless plain, particularizes his experience, fixes it in the varied context of landmarks, people, events, names. And because these are so few in the Arctic, each one matters. Every man is memorable, every occurrence an event, every minor landmark has a name.

So when Paul von Baich returns from the Arctic, he does not talk in generalities. He talks in concrete pictures, pinned to memory by names and native phrases that still ring in his mind. Guttural, strongly articulated, their alien vigor alone suggests the gravel shores and grinding pan ice of the land to whose tongue they belong; and the chiseled, mobile, merry faces of its people. Tomasik Nutarareak, the hunter he accompanied; Urraukurru, one of his dogs; "Zirrgdu! Kutchi! Anja!" the shouts he hurled at it; Aukanerjuak, the straits to which they traveled to hunt seal: my friend's eyes light up when he utters them.

Yet even for him the nameless, indeed unnameable, looms large behind such immediate, particular impressions and images. As he talks, time and again his words seem to come up against it, trail off across remembered impressions for which no words can be found. "And on we went, hour after hour, all day, through the evening, till night, through the night, into the morning . . . the tracks led off into the west . . . ." I couldn't tell why he laughed. He seemed to see or recall something.

Vast perspectives open everywhere. A small, faraway scene can come to stand for the entire land and the ways of its people as they are and, perhaps yet more suggestively, as they have been since time immemorial. Traveling by DC-3 in April, 1968, Paul had barely left Hall Beach on Melville Peninsula when, peering through the porthole of the plane taking him

“Spread in the f
hitch, the dogs tr
yap, trot, trot..
The white expan
drags pa
the blown snow is
steady sting...

to Igloolik, he caught sight of a silhouette that might have moved against that same skyline a hundred years ago, or five hundred: an Eskimo driving his dog team. A trotting muffled figure, a *komatik*, a team of dogs trotting in front. Slowly, without seeming to take the least notice of the roaring machine, they fell behind and vanished as they had appeared. An everyday glimpse of a particular man at a particular moment, embodying at the same time a vision of his entire people back into their dimmest past.

The land is vast beyond conception. Neither mind nor senses can cope with its extent. It just goes on and on. Yet my friend denies that it is ever monotonous—even on a long sled journey, when nothing but its interminable snowbound expanse surrounds you. Colors, shades, textures; patterns of snow and of sky perpetually modulating, dissolving, and reshaping the few simple themes that define it. To the alert eye, its sameness is never the same. Small wonder that its inhabitants are said to have dozens of words for snow, but no generic term.

But it isn't always easy to keep alert. The photographs alone should make that plain; and, grudgingly, even my friend admits it. He crouches on the sled, huddled away

"And the cold
and stiffness . . .
creep back
into cramped limbs,
while deep
under hides and clothes
an empty stomach
rumbles on. . . ."

om the wind, hours of cold and iffness in his bones, unrelieved ave for the occasional stop to un- ngle traces, ice the runners, or ave tea. Spread in the fan hitch, e dogs trot, yap, trot, trot. Time rawls; the cold creeps deeper and eeper into never sufficient layers f woolens and fur. The white ex- anse drags past, the blown snow is steady sting, the skyline slowly reeps across distant, fading con- ours. Behind on the sled, Tomasik, ointed hood nodding, slumps in a eap. He has been silent for some me. For hours his shouts and muf- ed calls, emphasized now and then y the snap of an unerringly placed hipstroke, had urged the team ahead. Now even its master has succumbed to the dragging hours. Tomasik has nodded off. A dog turns his head, lags a little, is yanked forward, spurts back into place. Another one looks back. Then another. The sled slows down, stops. The dogs stand around, throw cautious glances at the huddled figures on the sled, then, very quietly, lie down. Utter stillness descends. Only the drifting snow still moves in the silence.

Suddenly a terrible yell makes my friend duck his head. "Urraukurru! K'nga!" The whip cracks, the lash sizzles through the air. "Ai, ai! K'nga! Oa oa!" An avalanche of raucous curses hurtles over the team. The whip lashes out in long loops, each ending in a sting and a whine. The dogs scramble, the traces pull taut, the sled yanks forward and resumes its swish and creak over the snow. Slowly, the imprecations grow intermittent, the whip flicks less fiercely, the commotion subsides and soon evens out into the smooth trot and flow of another long haul. And the cold and stiffness, briefly forgotten in the bustle, creep back into cramped limbs, while deep under hides and clothes an empty stomach rumbles on toward that faraway stop for tea.

One readily associates cold and discomfort with such a journey, but

At long last
a throaty call stops
the dogs; the sled
comes to a halt.”

I think one likes to believe that it proceeds in as relaxed a fashion as is compatible with freezing noses and semiparalyzed extremities. Not so, von Baich recounts. Hurry is no prerogative of the harassed city commuter, it would seem.

“Tea now,” Tomasik will at long last announce, just as one feels the stage approaching when even tea might be too late. He grins hugely into the biting wind. But one would be quite mistaken to conclude that he is ready to halt the team. Instead, he urges it on with another call and crack of the whip. As the dogs give another burst of speed, he pries open the lid of the grub box, fetches out the pot, and bending over, scoops up several potfuls of snow, pounding each portion firm for better yield. Yelling at the dogs lest they conclude they have been forgotten, he then digs out the primus, sets it up before him, spreads himself into an enfolding windscreen, rips a tuft of caribou hair from his trouser leg (already sadly denuded of fur in the convenient area), holds a match to it and, using it as a primer to preheat the valve, proceeds to light the primus, cursing loudly at wind and dogs when a gust blows it out, and even yet more loudly when, relit, the wind-driven flame singes eyebrows and hood. He pumps it up to full blast with a series of strokes, puts on the pot, cracks the whip, and on you go over the snow at 20 to 30 below, while behind your back a potful of the same substance is miraculously changing into boiling water. At long last a throaty call stops the dogs; the sled comes to a halt. You heave yourself off and drop into the snow. Tea! Black, with plenty of sugar! If you have any. Black and bitter otherwise. Ah, sweet hot tea. Or bitter hot tea. It's good, too. Unimaginably good. So good and hot that you generally burn your tongue with the first sip before you remember to throw some snow in to cool it. Of all the gifts from *kabluna*, “the white man,” none is as warmly appreciated as tea. And tobacco. So you take time out for a smoke too.

‘What modest shelter
you put up
against the elements
throws you together
in a physical intimacy
that renders claims
to privacy and
barriers of language
meaningless.”

Yet you seem barely to have begun sipping when Tomasik is on his feet again. He dips a small piece of polar bear fur into the dregs of the pot and passes it over the runners of the overturned sled. Icing the runners, a most important operation to insure smooth progress over the snow, is especially vital on a cold day when frictional drag is high. Tea is thus useful for more purposes than one; although fluids other than tea may also be used for icing runners. Such as the one resulting from its imbibition. Very economical and handy, and truly affording an object lesson to our wasteful society. Or you can use water, blood, a piece of seal liver, any aqueous substance; for a binder, use flour, rolled oats, mud. One or the other is generally at hand. So, not much time is lost before you and the dogs have to scramble to your feet again. The traces are untangled, the sled turned upright, pot and cooker stashed away. On you go.

On and on and on—once you *do* get going on such a trip. The trip itself may be delayed for days and sometimes weeks, for reasons generally unfathomable to you. Then out of the blue you are told, “We go now,” and you're off, still bundling your belongings atop the sled while trying to remember what you forgot in the sudden rush and none the wiser as to what could have precipitated the abrupt decision. When you ask how far it is to your destination, you may be told, “one sleep,” or “two or three sleeps”; all depending neither on our notions of bedtime nor measurements of distance, but simply on the Eskimo's inclination to sleep or to go on. He knows very well how far it is, and he has a shiny new watch ticking on his wrist. But the one is an abstraction, the other an ornament. He won't have his ways ruled by either.

Tomasik took Paul to [illegible]juak, which is shown on maps as Fury and Hecla Strait, a distance of “one sleep” as it turned out, meaning that they kept going most of one day, all of one night, and part of the following morning. When they arrived, they built an igloo. That is, Tomasik did. The igloo was up in half an hour. When Paul offered to help, Tomasik thanked him saying, "Maybe no good." A remark, says Paul, that tactfully summed up just about all his efforts to be helpful to his various Eskimo hosts in the performance of their routine tasks. Not to speak of his attempts to emulate them. After a very short time he came to feel like a toddler trying to keep up with a good-humored, but hopelessly superior, big brother. Sometimes he would, half-surreptitiously, stir some broth a bit or pump a primus. Otherwise he stuck to photography.

It isn't merely the casual competence of the Eskimo that tends to paralyze your efforts to make yourself useful: it's the temperature too. You are almost always *ikki*, "cold"; and if not *ikki*, *okko*, "hot." Sweating hot. Tomasik, grinning encouragingly, was invariably *okko; okko* in his case evidently meaning just nice and warm. A distinction that separated you as effectively as evolution has separated the Amphibia from the Mammalia. You just weren't in the same class.

They hunted the "flow edge," the boundary between landfast shore ice and the moving ice of the sea. When they arrived, one seemed little less solid than the other, but Tomasik announced, "Some time she clear. We go sleep now," and that was precisely what happened. When they crept out of the igloo some hours later, open water was steaming into a leaden "water sky" as far as the eye could see. Tomasik took gun, harpoon, a length of rope, and a small skin-covered boat, and they went to hunt.

It was too overcast and the season somewhat too early for seals to bask on the ice, so they had to be shot in open water. To secure a seal, you have to hit it in the head, otherwise it will sink before you can retrieve it. A seal's head is small relative to its body and hitting it is no mean feat—a feat enhanced by the state of repair of the typical Eskimo gun. Nor is it certain that many seals will be seen during a day's wait by the flow edge, or that those seen will be within range. Also, on trips to not-too-distant hunting grounds few provisions are taken for dogs or men, the Eskimo counting on a kill to provide them with sustenance, and with fur and skin for the entire family, household, and equipment. So a grown seal means a lot to the Eskimo (so much, in fact, that the notion of killing a young one strikes them as the height of unreason). But, even taking all this into consideration, Paul was not prepared for the shout Tomasik let forth when he missed his first seal. It was, he says, nothing less than neolithic in its unadulterated fury and frustration. He is convinced the poor seal who provoked it will never dare show his head again in Fury and Hecla Strait.

However, Tomasik got his seal before the day was done. There was a great feast of boiled meat and blubber, preceded by tasty hors d'oeuvres of the same substances raw. And, of course, numberless mugs of tea to go with it.

Most of the seal naturally went to the dogs. Their single-mindedness when it came to dealing with a seal carcass was a marvel to behold, Paul relates. They surround it in a tense circle—ears, eyes, and noses aimed fixedly at the center where Tomasik bends, chopping the meat with one hand, the whip in the other. He keeps the lash curling; now and then it snakes out at a too-forward customer. The last stroke: Tomasik straightens, and the carcass has vanished under a rush of snapping, snarling, gulping bundles of fur. Once Paul tried to hold the dogs back. For an instant his attention wandered; one dog pounced, and in the next instant no whip could have parted the growling mass.

"Not much time is lost before you and the dogs have to scramble to your feet again."

It wasn't just more country and a few seals they saw at the flow edge. They also met with other hunters down for seal. Natalino Atagutaluk, Michael Kopak, Inuki Kunuk, and Taktak, the village fool. Even the dogs seemed to have their fun with Taktak. It was obvious that they had had many a bite out of his *kolita,* or "parka," and at the same time taken good care to keep his whiplash chewed down to ineffectual length. It was little longer than a fly whisk. But he seemed merry enough in his role, and joked and gossiped with the others as they sat in their igloos eating, drinking, smoking, and sweating happily in

the steaming warmth. Everyone present seemed related to, or at least well acquainted with, everyone else, so gossip flourished. Paul could not follow the conversation, but he strongly suspects that many a chuckle was directed at his own mannerisms and antics. They must have furnished his hosts with an ample fund of material for then and future merriment around the bubbling pot. His pronunciation of Eskimo words seemed to amuse them endlessly. But he soon found that this also held for the slight deviations from "accepted speech" peculiar to other communities, some no farther away than Coral Harbor. So there was no reason for him to doubt his linguistic talents, which are considerable.

Good fellowship comes readily in that often desolate land. Indeed, it is impossible to avoid it: you could not survive. What modest shelter you put up against the elements throws you together in a physical intimacy that renders claims to privacy and barriers of language meaningless. On this level, even on a brief visit, you are drawn closer into the community of all men. When the trappings are gone, as they are when life is lived that simply, your needs and joys are seen to be much the same. You are part of a family, part of the chance circle men form against the danger and cold outside.

As you ride back under the moon toward Igloolik and first see its lights on the drifting snow that moves over the arctic lands and seas and islands, like a thin shroud spun on the wind that blows forever, you realize you are coming in from far. And are not much closer to home yet. The moon is a planet, and you are riding another. The earth? Igloolik might be a space station. In spite of cosmonauts and telecommunication, the earth seems very big, Paul says.

I think I can see what he means. It may be farther from Montreal to Manila than from Montreal to Igloolik. I have not been to either, but I feel sure that compared to traveling to Igloolik—then on with Tomasik Nutarareak to the flow edge of Aukanerjuak—jetting to Manila is a mere turn round a corner of our global village. A day's ride behind the fan hitch can take us farther than any propulsion engine. On earth, at any rate.

Can Leviathan Long Endure So Wide A Chase?

by Scott McVay

From the ocean depths a harmonious singer reminds his relentless pursuers that the fates of whales and men are strangely interconnected

A hundred years ago, Herman Melville asked "whether Leviathan can long endure so wide a chase, and so remorseless a havoc?" Today, in more prosaic words, the question remains: What would be lost if the whales were gone from the sea? Of what possible use are whales to men? Esthetics aside, who cares if the whale goes the way of the dinosaur?

These words sound terrible and ominous to me; yet they represent the thinking of many people, including some of the men who set the whale-kill quotas every June. Few of these men have ever seen a whale. Few of them had ever heard a whale until biologist Roger Payne, of the New York Zoological Society and Rockefeller University, played a recording at the close of the final session of the International Whaling Commission meeting on June 26, 1970, in London.

It was 2:00 P.M., and the commissioners were hungry. The chairman, Mr. I. Fujita, noting at the outset of the final plenary session that business would have to be completed before lunch, pointed out brightly that "hunger will expedite our deliberations." But some delegates, notably the Japanese and Soviets, lingered to listen to sounds recorded at a depth of 250 fathoms—the song of the humpback whale. Spanning *six* octaves, it filled the conference room at River Walk House overlooking the Thames.

Henceforth, the commissioners' annual deliberations will take on a new dimension. These sounds have already made a profound impression on the thousands of Americans who recently heard them in New York's Philharmonic Hall, on television, and on radio. The unexpected fact revealed by this recording and many others, according to the analysis by Dr. Payne and me, is that the sounds often fall into true song forms that are predictable in broad outline.

The humpback songs have captured the imagination of composers and musicians. In a musical ballad Pete Seeger wrote:

> If we can save
> Our singers in the sea
> Perhaps there's a chance
> To save you and me.[1]

This thought, these words cut right to the heart of the matter.

The decimation of the antarctic whale fishery is a grizzly story. It has been catalogued since 1920, when the Bureau of International Whaling Statistics in Sandefjord, Norway, began recording every *reported* whale kill by species, length, sex, date, and place of death. During the 1960's, the yield in barrels of whale oil dropped fivefold, from more than 2 million barrels to less than 400,000 in the 1969–70 season. The whalers might have taken more than a million barrels year after year, indefinitely. But their insatiability in the past two decades has so ravished the stocks and so decimated the large species that the sustainable yield today is but a shadow of what it could be if the stocks had a chance to rebuild.

Last year, most of the world's whale catch was taken by two nations, the Soviet Union (43 per-

The humpback whale, wrote Melville, "is the most gamesome and light-hearted of all the whales, making more gay foam and white water generally than any other of them." Here and on the following two pages, the humpback breaches in the Atlantic Ocean off Bermuda.

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[1] "The Song of the World's Last Whale," by Pete Seeger. © by Stormking Music, Inc., all rights reserved, used by permission.

cent) and Japan (42 percent). The remainder was taken by Peru (5.3 percent), South Africa (2.8 percent), Norway (2.5 percent), Canada (1.7 percent), Australia (1.4 percent), Spain (0.8 percent), and the United States (0.5 percent).

The grim figures for the past season (1969–70) reflect the catch of smaller and smaller whales in the warm waters of lower and lower latitudes. Twelve years ago, 65 percent of the catch was taken in antarctic waters south of 60° south latitude. Last season, 89 percent of the catch was taken between 40° and 60° south latitude. In the heart of the antarctic fishery, once the most bountiful whaling ground on earth and a seemingly endless resource, the harvest has dropped in a dozen years from two-thirds of the total catch to one-tenth.

In the age of sail more than a century ago, when the whale hunt was directed principally at two species, the sperm and right whales, and the old-time methods were no match for the elusive and fast-swimming blue and fin whales, Melville could assert with dreamy eloquence: "The whale-bone whales can at last resort to their Polar citadels, and diving under the ultimate glassy barriers and walls there, come up among icy fields and floes; and in a charmed circle of everlasting December, bid defiance to all pursuit from man."

Melville could not have envisioned the rapacious efficiency of modern whaling, which has all but eliminated the rich antarctic fishery. Today whales are hunted at both ends of their migratory cycle and, in the case of the sperm whale, on the way to the southern grounds.

Victor Scheffer deflates any notion of romance in the contemporary whale chase:

"In man's attempts to catch more whales more cheaply, he has tried to poison them with strychnine and cyanide and curare. He has tried to electrocute them. Spotters in airplanes and helicopters now search them out and report the position of the herds to whaling vessels below. The ships hunt them down by ASDIC, the system that can feel the whales in total darkness. A 'whale-scaring machine' frightens the beasts into flight with ultrasound and tires them so the hunter can overtake them. What will be next? Will the hunter cut a phonograph record of the mating call of the whale, or the cry of the calf for its mother, and play back the sounds beneath the bow of his ship? Will the orbiting satellite speak through space to tell the hunter where to find the last whale?"

In the past twenty-five years, 62,022 blue whales, at 85 feet and more the largest mammals on earth, and 15,025 humpbacks, perhaps the most playful of the great whales, have been taken in the Antarctic. Never very abundant, both species have been pushed to the edge of life, but are now nominally protected. The finback is the next candidate for "commercial extinction," that is, when its numbers will have been so reduced that it will no longer be profitable to send expeditions to hunt them. The finback, a smaller cousin of the blue whale, was second only to the sperm whale in abundance. During the past quarter-century, 444,262 finbacks were taken in the Antarctic, more than half of them from 1954 to 1962 when more than 27,000 finbacks were taken each year. Their population is now estimated at 67,000 to 75,000, one-fourth of its original size. If the exploiters had shown restraint—if they had learned the lesson of the blue and humpback, had remembered the slaughter of the rights and bowhead in the last century—then the Antarctic could have yielded 10,000 to 12,000 finbacks a year down the long hungry road of the future. Today the sustainable yield is estimated at less than 3,000 finbacks.

These numbers, combined with catch data, indicate the extreme pressure on the finbacks and are an indictment of the stewardship of the International Whaling Commission. The ravaged state of the whale stocks presents an essentially nonpolitical problem that could be eased enormously if the catch effort was radically reduced to allow all whale populations to rebuild. The most desirable goal of all, a ten-year moratorium—for tagging, study, and population counts—seems beyond the capacities for cooperation and restraint of the nations present at the International Whaling Convention meeting: Argentina, Australia, Canada, England, France, Iceland, Japan, Norway, Panama, South Africa, the Soviet Union, and the United States.

With the stage set, we can better appreciate what happened at the 22nd meeting of the International Whaling Commission in London at River Walk House, overlooking the Thames, last June. The actions and inactions of the commission can be gauged by four items: (1) the whale quotas set, (2) the sperm whale, (3) the International Observer Scheme, and (4) the action by the U. S. Department of the Interior listing all great whale species as endangered.

As an observer to the meetings, I would like to point out that while the United States is involved in whaling only marginally (it operates one small land station in California), the constructive influence of the United States on the commission has been considerable. Dr. J. Laurence McHugh, the United States commissioner and vice-chairman of the commission, and Dr. Douglas G. Chapman of the Center for Quantitative Science at the Uni-

Continued on page 68

The tail of a humpback ris
above the ocean off Bermud
Scientists know these migrato
whales are near when they he
whale songs on hydrophon
three miles off the islan

DINERS OF UNLIMITE

Animals that eat without mouths,
use chemistry and physics
to eliminate hauling food and
silken threads for silverware . . .
ingenious methods of dining
not observable at the local cafeteria
or, for that matter, at the Waldorf

by Jean Craighead George

About five years ago I accepte
an invitation to the annual banque
of the New York Zoological Societ
The dinner was to be held in th
Grand Ballroom of the Waldorf As
toria, and I am one who likes th
pomp and circumstance that su
rounds man's formal eating habit
I arrived early on that snowy nigh
eased my way through bedecke
guests, and took my seat beside a
elderly zoologist. We were the onl
ones as yet at the table, so I com
mented on the impressive stage se
ting for the feast, the variety o
glasses, the silverware and china.
was promptly told the entire proc

IVERSITY

re was highly unoriginal and undane.

"Living with us on this earth," e professor said in Oxford Eng-h, "are diners that would make se at this banquet look inept and imsy. Imagine being so refined u need never open your mouth to t. There is such an animal. Or try think of employing chemistry d physics to eliminate the awk-rdness of hauling food.

"Then," his eyes twinkled play-lly, "silverware of threads or autifully executed dances instead these shovels." He picked up a oon and a fork. "You really must become acquainted with the other diners that share this planet with us before you limit yourself to the admiration of man's table."

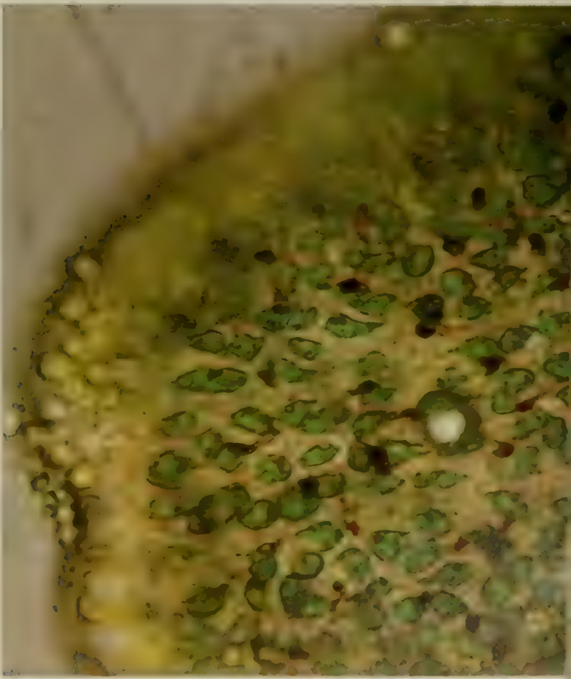
Other guests arrived, conversation crackled around us, and I had no opportunity to learn the professor's name or, more important, to ask him what animal eats without a mouth.

Intrigued by the professor's sophisticated diners, I began to search for them by questioning my scientific friends and, of course, the mouthless wonder came first. What kind of a face would it have? How would I recognize it?

A marine biologist at the Institute of Science, Miami, identified this creature for me. It is *Convoluta roscoffensis*, a worm that feeds on a "farm" that grows inside itself.

When the tide goes out in the English Channel, the sands of north Brittany and the Channel Islands of Jersey and Guernsey flash green as colonies of these quarter-inch worms crawl from shallow subterranean hideouts where they have anchored themselves during high tide and stretch themselves to bathe in light and eat without opening a mouth.

The worm manages this in the



A flatworm of the sandy coasts of the English Channel. *Convoluta roscoffensis* ingests green algae of the genus *Chlorella*. The living algae, shown above magnified 130 times, provide the adult worm with nourishment.

course of its life-span. In the spring when it hatches from an egg, it does at first have a mouth, and it forages for, and gorges itself upon, a certain green algae in the seawater. These algae remain alive despite ingestion, and the worm is soon green from head to tail. It then forages no more, but feeds upon the starches manufactured by the algae through photosynthesis. Instinctively sensing that sunlight is essential to its garden, the worm spends every moment that the tide is out basking in the light filtering through its transparent body. The light acts on the algae inside so that they can convert hydrogen, oxygen, and carbon into sugar and starches. These the worm absorbs, and so it need forage no more. The oval mouth in its pointed head degenerates from lack of use, and its digestive system becomes functionless and almost disappears. Within a few days it cannot use its mouth even if it wants to, and sunbathing is substituted for foraging as the emerald worms gather in colonies along the beaches, creeping in and out of the summer light to tend their "gardens."

Eventually the worm needs mo
nutrients than the starches can pr
vide, and it begins to eat the goo
that lays the golden egg. It slowl
devours the algae from its rear en
forward until it eats the last mors
and dies of starvation. The san
lose their green color, autum
comes, and a new generation
Convoluta roscoffensis eggs laid i
July awaits the light of anothe
spring.

The worms shelter the algae an
cannot live without them becaus
in this symbiotic relationship, th
algae not only provide nutrien

A solitary creature, the three-toed sloth may spend its entire life in one tree. In a *Cecropia* tree, above, it feeds on young leaves that make up the bulk of its diet. The American flamingo, far left, feeds in the mud, sieving out insect larvae, crustaceans, and seeds with its unusual bill. The roseate spoonbill, left, sweeps its spoon-shaped bill back and forth, filtering crustaceans from the water.

ut also utilize the hosts' waste roducts and give off oxygen that nables the host to endure stagnant onditions. Those worms raised exerimentally in the absence of algae iled to develop and died.

What an animal eats and how it hews is reflected in the contours of s face. For eating vegetation the abbit nibbles, then gnaws, then ith a rotating movement grinds its ood. Consequently, its front teeth re mounted in the forepart of a V-haped jawbone that affords the leerage of wire cutters. The molars nd premolars are well back in the mouth for grinding. Together the muscles and bones that work these teeth give the rabbit that cheeky look and characteristic deep chin. How, and what, we eat shapes our faces, too. Human teeth are designed to chew an omnivorous diet of meat and vegetables. Since we do not have to snip, and because we put our food into our mouths with our hands, we don't have that wire-cutter look of a rabbit. Instead, the human face reflects the grinding action of the rabbit plus the slicing or tearing movement of the carnivore. To cut meat, as carnivores do, a muscle near the ear slams the lower jaw down. To mash vegetables, the muscle that covers our jaw rotates the molars. This, together with the fact that we have not developed the long nose that accompanies a good sense of smell, gives us the flat, multipurpose eating face.

The mammals whose faces have been most obviously shaped by their food are the anteaters, which appear in several orders of animals. Armadillos, aardvarks, Chinese pangolins, and the common anteaters all feature long pointed mouths into which fit sticky tongues that are unmistakably designed for hunting in anthills. Even more perfectly shaped for ant hunting is the mouth of the spiny anteater of Australia (an egg-laying mammal). This two-foot-long termite-hunter has a flat hypodermic-needle-like mouth. Out of this shoots a seven-inch tongue that carefully selects only the soft ants, so that this creature has no teeth at all. It is the only mammal that does not have even the vestige of a tooth anywhere in its development.

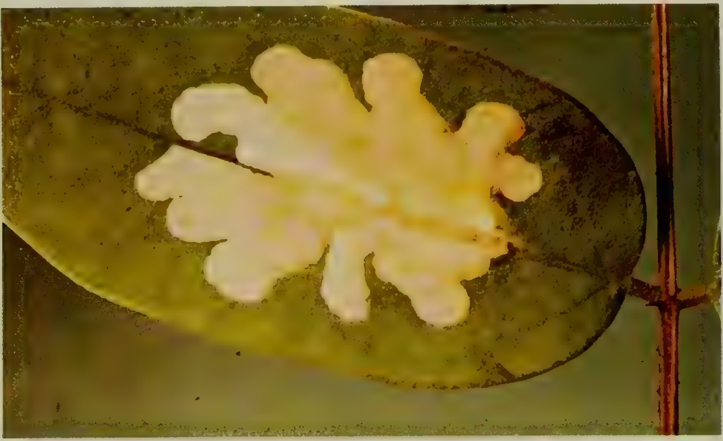
The bills of birds have been specialized into instruments designed by, and for, their food—often most dramatically.

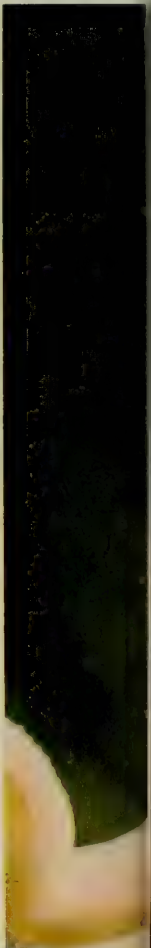
To open spruce and fir cones, the red- and white-winged crossbills of our northern boreal forests have evolved a beak as good as any opener that man has invented. The lower and upper mandibles cross each other near the tip and would seem to be deformed. When shoved between cone scales, however, the crossed "pliers" easily pry them apart. The bird's tongue then shoots in and plucks out the seed.

The bill of the roseate spoonbill looks awkward until its purpose is understood. Long, with a flat, spoon-shaped tip, it is swung back and forth in the mud. Into this bill swirls bottom debris that is tested against numerous nerves in the wide spoon; the living organisms are then swallowed and the inert matter washed out.

The need to separate snaillik cerithium mollusks from mud ha shaped the odd bill of the rose-colored American flamingo. With th bird's head completely submerged the bill, looking like the bent bowl of two facing spoons, is shovele along the bottom. The tongu pumps in water and a filter separates the food; water is shot up an out of the corners of the beak, an only the animal food is sent to th stomach where it is ground up b powerful stomach muscles.

The drill of woodpeckers, th hooked meat-ripper of the hawk and owls, the seed-crackers of th finches, and the forceps of the fly catchers all tell an ornithologis what a bird eats.





Eating the parenchyma tissue of a black locust leaf, above, the larva of one of the leaf-mining beetles, *Chalepus dorsalis,* creates a pattern of consumption. An aphis lion, right, larva of the lacewing family Chrysopidae, sucks out the body fluids of aphids. It then decorates itself with the aphid shells as protection from predators. The predacious dragonfly nymph, far right, devours a worm.

From time to time I kept an eye ut for the "chemists" and "physi- ists" that the unknown professor : the Waldorf had mentioned to ie. I suspected that I would find iem among the insects, for their outhparts, like the teeth and jaws f mammals, are good clues to their ating habits. Insects are divided to two groups on the basis of ese structures: chewing insects, ch as grasshoppers, and sucking sects, such as bedbugs and mos- uitoes. The variations on these two emes are seemingly infinite. The ghly predacious dragonfly larva, r instance, has a trapdoor-like outh, which it can slam shut on prey. The sipping butterfly has a iled mouth shaped like a drinking tube. The gnawing larva of one of the leaf-mining beetles, *Fenusa ulmi*, has developed jagged hooks to saw its way into a leaf.

One glance at the mouth and head of a giant water bug of the family Belostomatidae leaves no doubt that this creature is one of earth's more intriguing eaters. This family of North and South America are chemists of almost terrifying ability. They hold prey with their forelimbs, and with their proboscises, pierce the flesh of insect, fish, or frog, injecting them with chemicals that turn bone, muscle, viscera—everything except the skin—into a watery fluid that they drink through their tubes, or proboscises.

These fat bugs are somewhat oval in shape, and the adults can be readily identified by their habit of hanging head down on the surface of the water as they watch for prey. Tails up, they provide comic relief to the dreamlike quality of a pond on a summer day, but they fill me with horror. Not long ago as I was pushing my canoe into a lake near my home, I noticed a frog that did not leap with the others at the fall of my foot, and I picked it up. At first it seemed alive, for its eyes were clear and bright; its skin, tight and moist. As I turned it over, a giant water bug released its hold and dropped into the water. I looked from it back to the frog and saw it had burst and was draining

like a water-filled balloon. Slowly its eyes misted, its toes collapsed, and I held in my hand a limp carcass. I shuddered at witnessing that frog's body rendered into a watery brew by an insect.

The rapid liquefaction of the tissues is accomplished by a potent mixture of hydrolytic enzymes in the salivary glands, a horrible venom that no man can produce as yet, and hopefully never will be able to.

Almost equally talented is the aphis lion, a larva that eventually becomes one of the most delicate of adult insects, a family of the lacewing order. With its two long, slender, hollow jaws this small creature pierces aphids, whose juices slowly flow into the aphis lion by gravity until only the aphid's shell remains. The aphis lion then picks up the mummy and hangs it on one of many hooks that protrude from its body. The more it eats and decorates itself, the better its chance to escape its own predators. As its camouflage cover grows in number, it comes to resemble the aphid colony around it, a defense mechanism that further increases its chances for survival.

The ant lion, the odd-shaped insect larva of yet another family of the lacewing order, is the "physicist" that the British zoologist at the Waldorf had referred to. Anyone who has tried to climb a sand pile or dig holes at the beach can understand the principle of the an lion's dining room. The larva selects a spot in the sand or dry soi near an ant colony and digs its pi by pushing its head under the loos soil and tossing up grains of soil o sand with it. Circling backwar during this process, it eventuall creates a cone-shaped depression Just before the whole thing collapses on the digger, it stops working and leaves its tong-shaped jaw protruding from the bottom of th pit. In this position it waits fo hours or even days on the chanc that an ant will walk its way, tri one of the keystone grains of san at the rim, and then tumble down t the waiting jaws on the resultan landslide.

On rare occasions the ant lion is ot quick enough to catch the fallen nt, and the angulation of the pit estroyed, the prey starts to climb ut. If the ant lion is hungry, the nt never makes it. Before the prey aches level ground, the larva rows up showers of soil with its ead so that with every step forard, the ant slips three backward nd, as if on a rug, is drawn down the waiting jaws.

Another "physicist," the larva of e tiger beetle, also builds a hole which it lurks. This animal looks ke a cross between a disjointed inoceros and a worm. Its miniure trap resembles the holes eleant hunters dig and cover with aves and branches. A skilled orkman, this larva digs a hole in e soil often half a foot deep or ore. Since it cannot cover the trap th material light enough for an sect to crash through, it uses its ad to plug the hole. Bending its ck at right angles to its body in e wide opening, its grubby face ers up from the forest floor like it of dirt. The larva holds itself at top of the pit with hooks that oot out from a stout projection its rump. Eventually a victim mes along, steps too close to the va's face, and is seized. Prey in jaws, the larva drops into the aft. Should the victim be strong d fight back, the larva employs other mechanical principle to event itself from being hauled out its hole. With a ripple it releases hooks, lowers them farther down shaft, digs them in again, and pulls downward. With this winchlike action, it drags the prey to the bottom of the shaft, paralyzes and devours it. This larva's underground table does indeed make the Waldorf seem mundane.

On occasion, when tired, I have wished that the ceiling would open and a broiled steak drop down. On the other hand, I have not desired all the animal culinary arrangements I have discovered, the cutlery of a related North American species of that same liquefying giant water bug being one. This bug has a pair of switchblades as lethal as carving knives. These are directed to their objective by the two thousand preying eyes of this great water bug. The switchblades, however, are beautifully designed for snagging small fish, tadpoles, and insects. The lower joint of the front leg fits snugly into a groove in the upper joint and when closed is not detectable. If a fish passes within range, the joint flashes open and slams shut. The prey captured, the large, flat-bodied bug then injects it with its powerful juice.

To fastidious man, a truly appalling eater is the starfish. After it has succeeded in prying open a clam with its hydraulic feet, this animal then extrudes its stomach out through its mouth (a tiny hole in the center of the star) and slides it into the mollusk through a space, in some cases, as small as one-tenth of a millimeter. Once the stomach has entered, some species relax their hold and permit the clam to close upon their own stomach. Amazingly there is no evidence of any damage to the starfish. The gap usually increases as the stomach digests the food, but even this is not necessary. According to zoologist H. M. Feder, a starfish of the California coast, *Pisaster*, ate mussels that had been bound with wire to prevent them from being separated in an experiment he ran on these incredible diners of the sea.

While on the subject of appalling eaters, something to match it can be said about peculiar diets. The food of animals includes, as one might suspect, everything organic—the living, the dying, the dead, and the rotten of both plants and animals. One menu, however, truly stands out. The young of the sticktight flea, *Echidnophaga gallinacea*, eat the feces of their parents, a diet no other beast has tried, as far as I know.

Of all the diners of the animal kingdom, the bolas spider, the creature that dines with a thread, seems the most sporting. Its prey appears to have a far better chance of living than dying, for this little arachnid of the trees snags flying food in the dark of the night with a single line. The bolas is also quite conspicuous, a dangerous trait when enemies are nearby. Its back is adorned with crests and horns, and its belly is wrinkled and girdled with bumps. These ornamentations are not known to play an important role in the life of the bolas spider, but may serve as protections by helping the spider to resemble a bud, nut, snail, or a bit of bird dropping.

The female bolas is the wonder, for she is the great hunter of this species. The male, interestingly, is born fully mature, and is no larger than the head of a pin. (The female attains a size of about one-half inch in length and width.) By day the female hides under leaves near the tips of twigs. When night falls, she moves down her twig until she is over an opening in the leaves. Fastening a thread to the underside of a branch, she picks it up so it won't stick to the bark, makes a loose loop, and secures it near the tip of her twig. Letting herself down to the middle of this silky trapeze, she reels out another thread about two inches long. Down this she combs out a quantity of viscid silk, which rolls to the end and forms a sticky globule roughly the size of a small bead. She then drops this line and ball out until it approaches its natural point of equilibrium, enabling her to swing it easily to and fro in any direction. Then she cuts the thread and is ready to hunt the night through.

Leaning from her swing and holding the line in her feet, she waits with uncanny patience for an insect to flutter by. Hours may pass without success, but eventually a moth flutters within the circle of

hile clasping a captured
opard frog, a giant water
g of the Belostomatidae
mily injects the frog
th chemicals that turn
erything—bones, muscle,
d viscera—except the
og's skin into a watery
id. The water bug
en drinks the broth
rough a proboscis.

The long, thin, flexible needles of white pine trees are the chief diet of the larva of the pine moth, *Panthea furcilla.* Crawling out on the needles would cause it to dangle precariously, so the caterpillar has developed the adaptive feeding habit of bending the needles back and eating from a secure perch.

her weapon. Judging the distance to the flier, as well as the speed at which it is traveling, the bolas swings her line and ball in the direction of the flight, strikes the moth on the underside of its fore wing, and waits. The line stretches with the momentum of the flying body and then contracts, bringing the struggling moth back. The spider descends her line, kills the victim with a venomous bite, and swathes it in a sheet of silk. She then carries it up the silver thread to her trapeze among the leaves and dines on its body juices. The meal completed, the bolas drops the empty bundle to the ground, reels in her swing, and goes home for the night, her food needs usually well met by a single sizable victim. Should her hunting prove unsuccessful, she winds up the globule and line and proceeds to eat it! She then quickly puts out another line and sticky bead and resumes her vigil. When I first learned of the bolas, I remembered the distinguished zoologist who was bored by dinner at the Waldorf, and I then knew why. Humans hardly seem to be in the same league with this dazzling procurer of food.

Another unusual hunter is the archerfish of the freshwater pools of the South Pacific islands, a pumpkin-seed-shaped fish that is the William Tell of the fish world. Cruising just beneath the surface, eyes peering through water into the air, the archer has evolved the skill of using water as a weapon. When the fish sees a dragonfly resting on a leaf, for example, he sucks in a volume of water, surfaces, aims, squirts, and knocks the insect from its perch. He snaps and eats, then cruises along waiting to use his watery arrow again.

A few of the earth's creatures eat with implements. How such behavior evolved is a source of scientific speculation, but this much is known: smart individuals do make discoveries and teach them to neighbors and young. Over the eons this knowledge is stored in the genes to become, if not instinctive, certainly readily learnable within a species.

The shrikes of the Old World and the Americas, songbirds with hawklike behavior and hook-tipped bills, use tools of a sort. Birds of dashing looks, usually with black eye bands, they do not have the powerful feet and talons of falcons and accipiters, but small feet like a robin's. Consequently, when they chase a bird or insect, these birds can neither kill with their feet nor hold on to their food while they tear it apart. They deal a death blow with their beaks and bring their prey to the natural skewers of the wild thorns of trees and bushes. Here they impale their victims, not to insure death, but to secure them while they feed.

The northern shrike hunts from the top of a tree, scanning the countryside for every moving object: bird, mouse, or insect. When a flock of sparrows passes below, the shrike dives into their midst; as a selected sparrow twists and dives, trying to escape, the shrike also twists and dives, attempting to match every movement of the prey so that it can be driven to the ground. There the sparrow is dispatched by the shrike's hooked beak.

Now the thorns of the area be-

come the bird's focal point. Taking off from the ground, food in his beak, the hunter flies to a tree, stands above a thorn, and spears his meal. There he eats or, if not hungry, simply leaves his food until he needs it. Occasionally, there are no thorns available, and the shrike either hangs his food on a nail in a post or barn or drapes it by its head from the narrow crotch of a tree, like a duck in a Chinese market. The loggerhead shrike, the smaller of two species that range from Alaska through Canada to Mexico, feeds largely on insects. He hunts from low fence posts and bushes and makes his presence known by impaling locusts and grasshoppers on the barbs of wire fences. I have seen many fences in summer that resemble an entomologist's collection box, telling me that the loggerhead is about.

Another tool-user is one of the Darwin's finches. This woodpecker finch is a small bird found on several islands in the Galápagos, that volcanic cluster of isles that lies 650 miles west of Ecuador. Here dwell some of the most unusual animals in the world: the cormorant that cannot fly, the four-foot-long iguanas, and the great lumbering Galápagos turtles. Darwin discovered many of the odd creatures here and was particularly enchanted with the finches, later named after him. Of them all, however, the woodpecker finch is one of the most interesting food-getters of the bird world, although Darwin did not know this at the time. It uses a sharp twig to get insects out of a tree, as a man uses a fork to get pickles out of a jar. When hungry, the perky finch searches for a twig or cactus spine about an inch and a half long. The right one secured, the bird takes it in his beak and flies to a tree, usually a dead stump, where he pokes it into a crevice with his beak and spears an insect. Shifting the tool to his foot again, he eats, then promptly takes the twig in his beak and continues hunting.

The charming sea otter of the northern coast of California, like a Galápagos finch, is a true tool-user. He picks up a rock with which to smash the hard-shelled abalones that make up the main part of his diet. An otter will dive, find a shell, and if it is too large and hard to bite open, he will swirl to the ocean floor again and pick up a rock. Pressing it to his chest, he surfaces and rolls on his back. Banging with the rock, he breaks open the abalone and picks out the delicate meat with his paws.

Shell smashing is limited to the sea otters of northern California where abalones are abundant. The same species in Alaskan waters has never been observed to use a stone as a tool, perhaps because it feeds primarily on burrowing sea urchins.

Occasionally, individual animals or isolated groups of non-tool-using species will hit upon the idea of using an implement to serve a need. A group of chimpanzees in the Gombe Game Preserve in Tanzania hunts termites by poking sharp twigs into their burrows and impaling them. Not far from these animals along the Gombe Stream, primatologists have observed individual chimps blotting up water from deep tree holes, which they can't get their mouths into, by dipping in mashed leaves and using them to soak up the moisture. And one individual who certainly deserves special mention was observed picking leaves and using them as toilet paper to clean itself after defecation.

In the mountains of Japan, some macaque monkeys use water to soak grain in order to clean the food. Syuzo Kawamura, a Japanese primatologist who has studied the macaque monkey clan of Takasakiyama, sacred animals that are fed and protected by an order of monks, tells of a female who scoops up a handful of soy beans and rice, runs to the stream, and [illegible] herself beside a pool, dumps her sandy ration into the water. The dirt sinks to the bottom and the grains float to the surface. She then [illegible] the cleaned grains.

A few other monkeys observed her activities, figured out what she was doing, and now also soak grain, although others cannot quite get the idea. Of these, however, a few have figured out something else, and when the soakers go to the stream to eat, take up positions below them. The downstreamers have learned that grains escape the fingers of the soakers and are carried on the water to them.

Some of these monkeys also wash potatoes for probably the same reason, a trick that was discovered by a young female monkey who taught it to her playmates, who in turn, taught it to their mothers. A joyful in-group of females then gathered together for potato washing.

Tool using seems appropriate among apes and monkeys with their prehensile hands and kinship to man, but what of a vulture who cracks an ostrich egg by throwing a stone at it?

Several years ago Jane van Lawick-Goodall and her husband, Hugo van Lawick, were driving through Serengeti National Park in northern Tanzania. They brought their car to a sudden halt beside an open field for they could not believe what they were seeing. Two Egyptian vultures, yellow-cheeked white birds about the size of ravens, were standing before an ostrich egg. One of the birds had a stone in its beak. While the van Lawicks watched, the bird threw back its head, flipped its neck forward, and hurled the stone. It struck the egg with a whack. The vulture then walked up to it, saw that the shell had not broken, and picked up the stone again. The next pitch missed the egg entirely, but on the third try the shell cracked, and a few more blows opened it. Hardly did the vultures bury their beaks in the yolk when they were driven off by larger vultures, the white-backed, hooded, and lappet-faced, which had been standing in a circle watching them. The bigger birds were apparently not intelligent enough to learn from the Egyptians, but they did understand the consequences of their efforts and waited patiently for the feast.

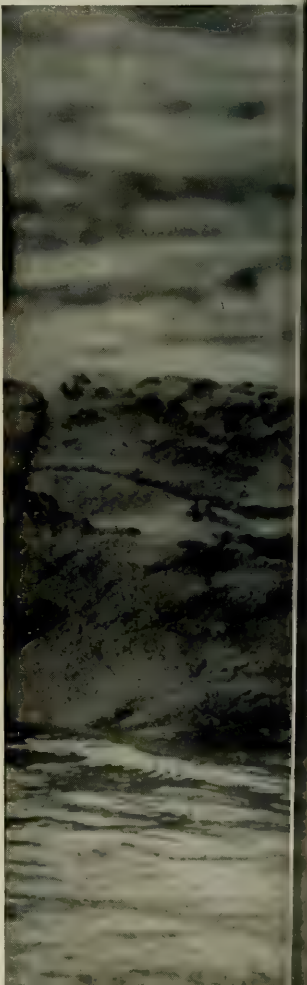
A few Egyptians have learned to outwit the larger vultures. Two observed by the van Lawicks approached a deserted ostrich egg and, while one stood guard, the other hurled stones. With threats and cries, the guard drove off the scavengers so that by the time the egg was broken the arena was clear for the Egyptians to feed.

The Egyptian vultures are so egg-oriented that they threw stones at all spherical objects the van Lawicks presented them: real eggs, false eggs, big or small. The bigger the object, the more excited they became. Several alighted too far away from these objects to be within striking distance, but tossed stones anyway.

The dining rooms of wild creatures are generally where their food is caught, but not always. Some carry their meals away to spots more appropriate for dining. The most breathtaking is the table of the swallow-tailed kite of Florida's Everglades. This bird is a glorious flier who swings through the sky on pointed wings and climbs high into the heavens. Dropping back toward earth, it pirouettes like a dancer. It seems fitting that this sky lover should choose the high winds for its eating place.

After catching a snake or large insect, the kite flies upward until it meets a breeze upon which it can spread its wings and sail, almost motionless, in the air. Then, its tapered wings open, the bird leans down and snips tidbits. I have never watched this performance without wanting to sing, for there is something about a bird dining on a table of wind that lifts the spirits.

Like the mouthless *Convoluta roscoffensis,* the animals whose spoons are dances lingered in my mind long after the dinner at the Waldorf was over. Two years ago found them in one of this land' most beautiful environments: a vernal pond tucked among hemlock beside a great boulder in a New York forest not far from my home The day was in March, snow sti covered the ground, and the pon was black and patched with ice. A I stood on the rock looking down, noticed bright colors in the wate



A young female of the Takasakiyama troop of Japanese macaques discovered how to wash potatoes in a stream. This behavior may be useful for cleaning the food. Several macaques in the clan learned from her example and now wash their potatoes before eating them.

nd, leaning over, saw that the ond was astir with fairy shrimp, ny branchiopods that swim forever n their backs peering up at the pring skies through large black yes. Rainbow-colored filaments reamed from their bodies like arves as they darted and turned the water. I was entranced, for iry shrimp can only be found uring the two weeks of each year hat precede spring. After returning ome, I leafed through a zoology ook to learn more about them and iscovered that at long last I had ound the dancers of which the pro-ssor had spoken.

Along the margin of the fairy rimp's body are ten flaps that stand up like dividers in an index file. These are used for both swimming and feeding. Water runs over these flaps and flutters them in complicated combinations so that some close, others part, and still others fall wide open. The plankton-rich water is jetted across these by the dance of the shrimp. As they shoot forward, backward, and down, food catches in the flaps and drops inward toward the body of the shrimp where it is picked up by tiny filters. A shift in the shrimp's dance closes the flaps, and the food is shuttled up a groove lined with hairlike setules. These hairs whip it to the mouth where it strikes glands and stimulates them to excrete an adhesive material. The glue and food form a ball, which the shrimp picks up with its top jaw and shoves into its mouth.

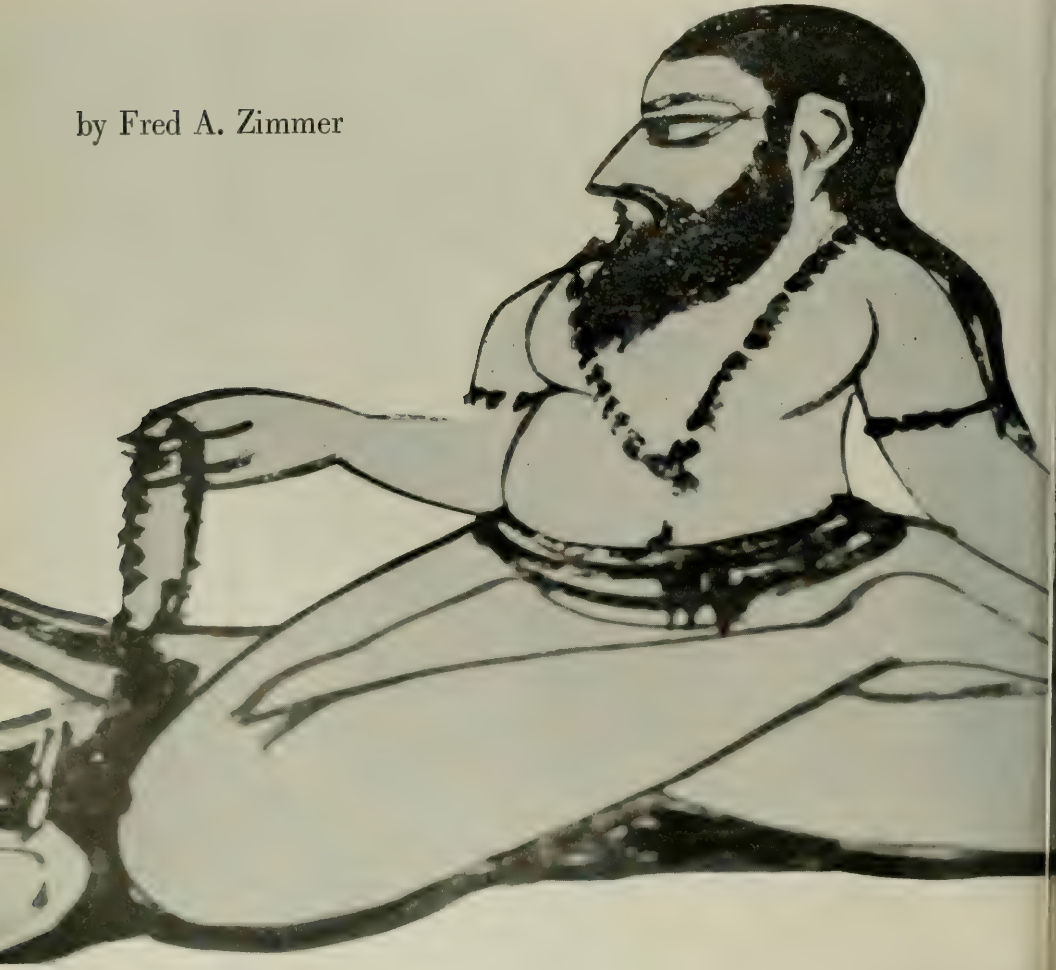
Early the next morning I returned to the pond, and stretching out on a rock watched with comprehension as the fairy shrimp danced while they ate. I saw them change directions to close their flaps, then swirl in another direction to send the food to their mouths. A gray-streaked sky hung over me, a flock of silent red-winged blackbirds moved north through the trees, and the seven-course meal at the Waldorf did indeed seem heavy-handed and unimaginative.

Green is for Coolnes

The medium is literally the message of India's wall art, where pigments, symbols, and figures relate epic history and express hope for a bountiful life

by Fred A. Zimmer

Wall paintings in India often seem to be merely charming, exotic decorations. Yet these painted walls, with their elaborate surface configurations, carry a complex range of information. To the urbanized, Westernized elite of India, they are usually not too meaningful. But to the Indian villager and his wife, pictures are a vital part of their world view. Just as Jesus, Cain, and Abel were known to medieval man through visual representations in churches and cathedrals, stories about Rama, Krishna, Parvati, as well as local deities, are real, familiar, and pervasive to



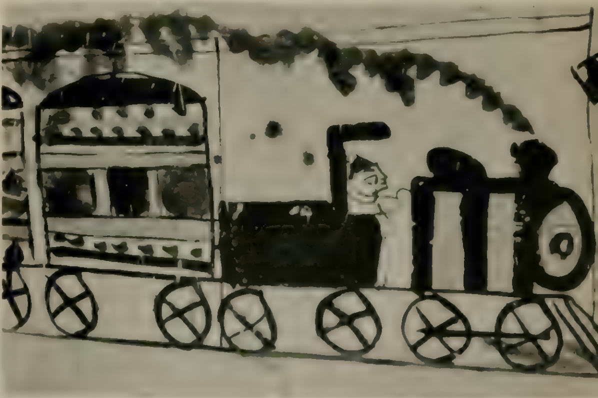
ellow for Good Auspices

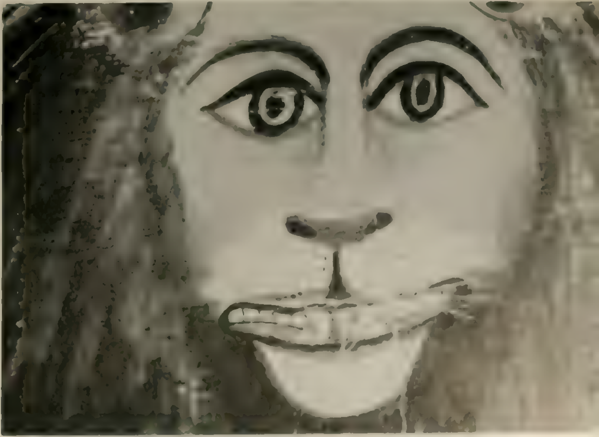
hese Indians. Social messages—about weddings and hildren. about good luck and bad—come through as vell. For although 75 to 85 percent of Indians are lliterate, they communicate in ways other than writng. Many media, in Marshall McLuhan's language, re the message. You might even say that India repesents a high—perhaps the highest—development of he preliterate village to which McLuhan sees this ostliterate age returning by way of electronics.

With its fourteen official languages, almost as many lphabets, and proliferating dialects, it was perhaps nevitable that this vast subcontinent evolved a common visual language. Mass communication has been going on in India for many millenniums and wall paintings have contributed to the process.

One aspect of Hinduism is the idea of pollution and ritual purification. A Brahman, for instance, must be aware of what, when, and with whom he eats, where his water comes from, and even whose shadow touches his. Since all sorts of people and situations are potentially polluting, he must identify them quickly. The resultant system of visual shorthand makes India one of the most symbolizing countries in the world. Not just pictures, but each act, each color, food, and way of

Depicted on the outside wall of a temple entrance, a holy man, left, sits in meditation holding his prayer beads. At right, a secular wall painting finds its subject in modern times, while in contrast, below, an ancient symbol gazes from a temple wall and tells which god is worshiped inside. This detail of a lion symbolizes the goddess Devi.





winding a turban says something to those who know how to read the signs.

Because traditionally in Indian painting the medium is literally part of the message, it is important to select the right ingredients with the proper magical attributes. Because it is auspicious, rice paste—mixed for the same reason with water, ghee (clarified butter), and sometimes goat's milk—is used for wall, floor, and ground pictures. Coloring comes from natural sources, although in recent years chemical powders have been used. Turmeric is traditional for yellow, and red comes from earth, flowers, or berries. Ground seeds make black; pollen, orange; and powdered leaves, green. And the intrinsic properties of the materials are as important as the colors they produce.

Colors have built-in meanings often based on codes from previous centuries. Green carries coolness and peace of mind. Yellow is particularly auspicious and used, along with red, at Holi, a major religious holiday. Red-yellow ocher identifies saints.

Artistic pursuits are more integrated into daily life than art as we know it, which tends to be abstract, compartmented, and subtly alien. Temple workshops have always trained Indian craftsmen to paint, mold, and carve images, performing much the same role as the churches that trained the anonymous craftsmen of Europe's Middle Ages. Certain craftwork is traditionally done by special castes. For instance, hereditary potters, the kumhars, still crouch on the ground to produce, on primitive, stick-driven wheels, most of the clay vessels for everyday use. Making masks for festivals is a similarly specialized activity.

In rural villages household members, usually women, make the wall and floor paintings. These skills are part of their training and dowry, and they learn to embroider, paint on cloth, and use straw and clay as well.

If the house is fairly well to do, with several rooms, their efforts usually center on three locations: in the puja room, where the family deities are kept; the "honeymoon room," where newly married couples are installed; and the veranda, where the main entrance and perhaps the small niches for oil lamps and candles often provide a focus or central design axis. The messages are drawn, pressed, painted, or plastered on the walls, on a surface of smooth mud and cow dung, which in particularly prosperous families is whitewashed with lime. While types of crude brushes are often used, an especially direct method of application is the multi-hand-print in which people simply dip their hands in color and press them on the wall. This is done to invoke bounty or fertility on specific holidays and at marriage festivals.

Brightly painted peacocks and other birds, wild animals, trees, and flowers appear in symbolic colors and often represent specific deities, accompanied by their favorite or appropriate foods and flowers. Domestic animals, potted plants, and the actual names of gods may also appear, as well as an occasional bicycle, automobile, or train.

In figure painting in village houses, two triangles frequently represent a woman; one triangle or square, a man—certainly a minimum of design shap to indicate sex differences. More easily recognizab elements are gestures, facial expressions, or person ornaments. In a Brahman household a typical painti made in gratitude for the birth of a son will inclu the popular man-woman motif: a god and his wi such as Shiva-Parvati or Krishna-Radha. These fi ures are often filled with a large number of symbols- fingerprints for fertility, suns, moons, children, a general signs of prosperity.

Sometimes designs are precisely drawn and fill with geometric figures, occasionally made from pap patterns. A puja, or worship, sign from central Utt Pradesh is made up of four sides, four crosses, a eight dots, a total of sixteen units, the number household gods. The oldest woman of the house pa homage to the household gods and participates wi other community women in making such marks wi red ocher and ghee on the outside wall of her hou on specific ceremonial days.

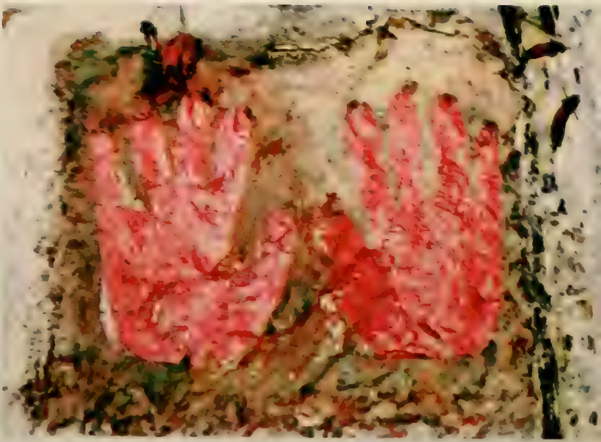
Stylized sacred lotus flowers and pipal trees wi large, fanciful geometric blossoms are featured in th elaborate designs of the folk art in the eastern state Orissa. Based on interlocking circles, they are ma for special festivals or marriages and used to welcom Lakshmi, goddess of prosperity, during the autum festival of Dewali.

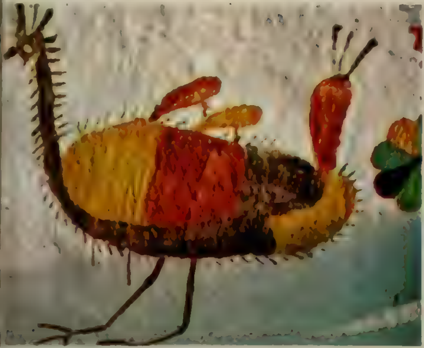
Shops or houses with small cottage industries ofte use designs to gain favor with gods and goddesses. magical number series set in nine connecting squar reads as a charm for completeness, wealth, and pro perity. Such signs are usually made by priests on th doors, walks, or walls of the establishment.

Numbers, letters, and eyes can be worked into circ lar or triangular combinations to exert special i fluence or to exorcise evil spirits. *Aum*, or *om*, th Sanskrit for "truth," is a favorite word symbol. Th Shatkona, or six-pointed Hindu star, identical in shap to the Star of David, symbolizes propriety and immu ity from impious things and events. A fish represent peace and coolness.

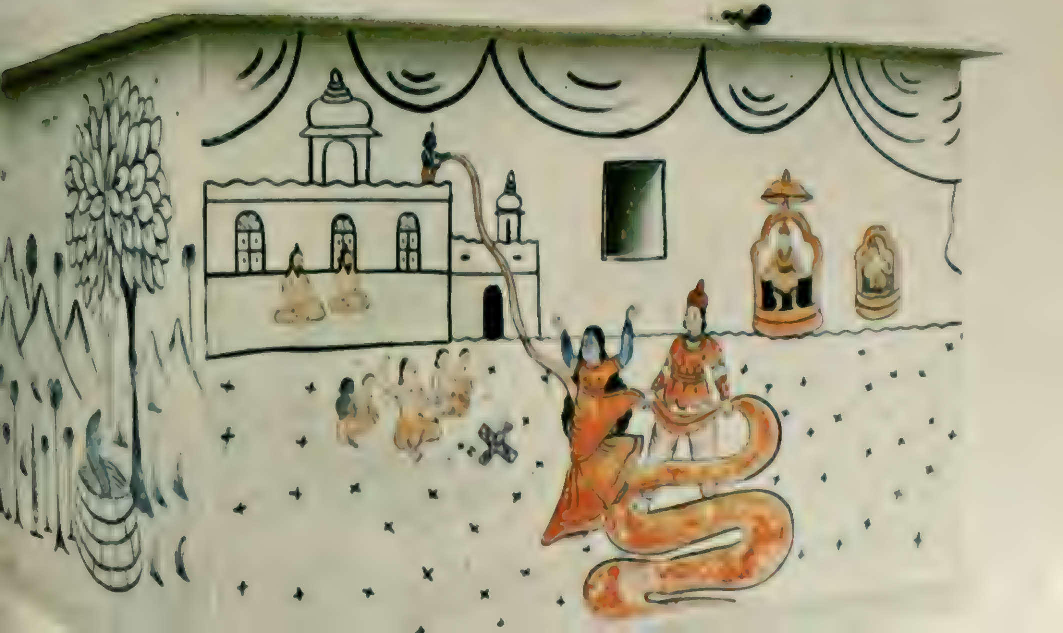
Wall and house painting might be called privat sector symbolizing. At festival time, professional vi lage artists and special caste artists indulge in a publi orgy of symbols. The more important the occasion, th more levels and kinds of objects are incorporate Metals, fabrics, gestures, songs, colors, stars, dresse masks, paintings, and even food and water, proper ordered and placed, do not just create a festive moo but cram a maximum number of messages into th event. Taken all together, the objects' messages relat to the concept of dharma, to do that which is right a cording to one's place in life.

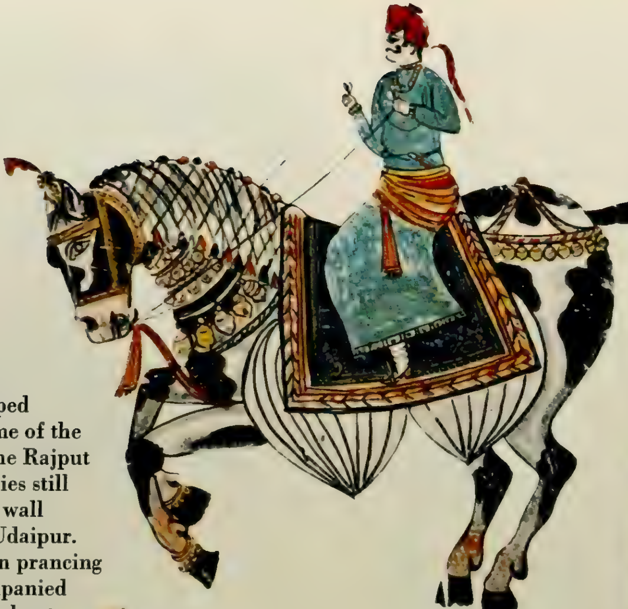
Auspicious hand paintings, in slight bas relief because of their base of crumpled foil paper, abound on house fronts and street corners in Rajasthan and invoke the good life. The peacock, below, India's national bird and a good luck sign, discourages evil from entering a house.



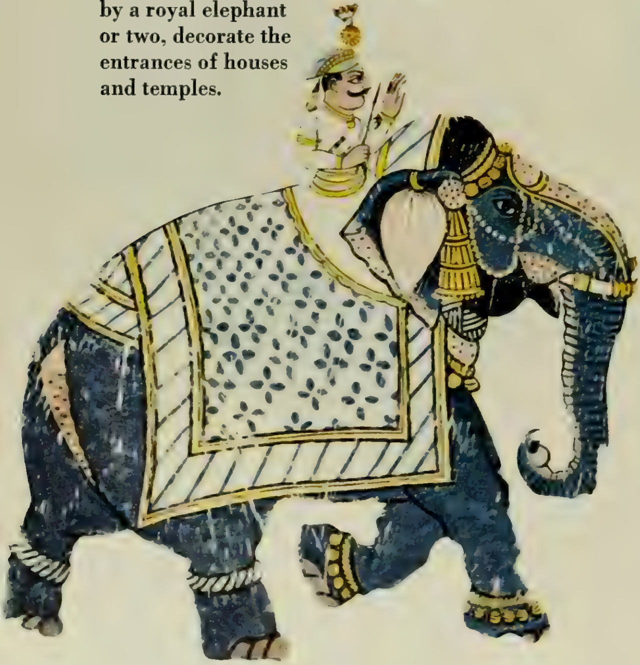


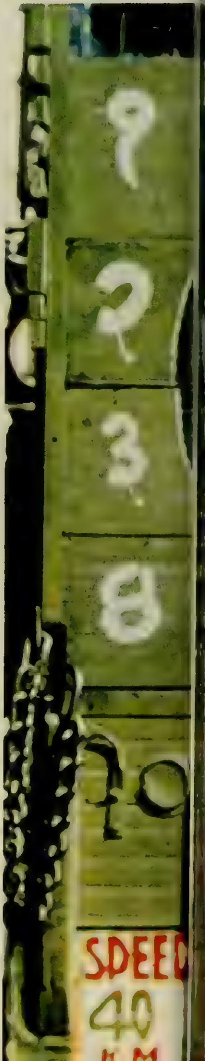
Famous incidents from two great Indian epics, the Mahabharata and the Ramayana, are popular festival wall topics. In a private backyard shrine near Benares, below, narrative scenes give life to the religious classics.





Styles developed during the time of the Moguls and the Rajput Hindu dynasties still appear in the wall paintings of Udaipur. Guardsmen on prancing horses, accompanied by a royal elephant or two, decorate the entrances of houses and temples.



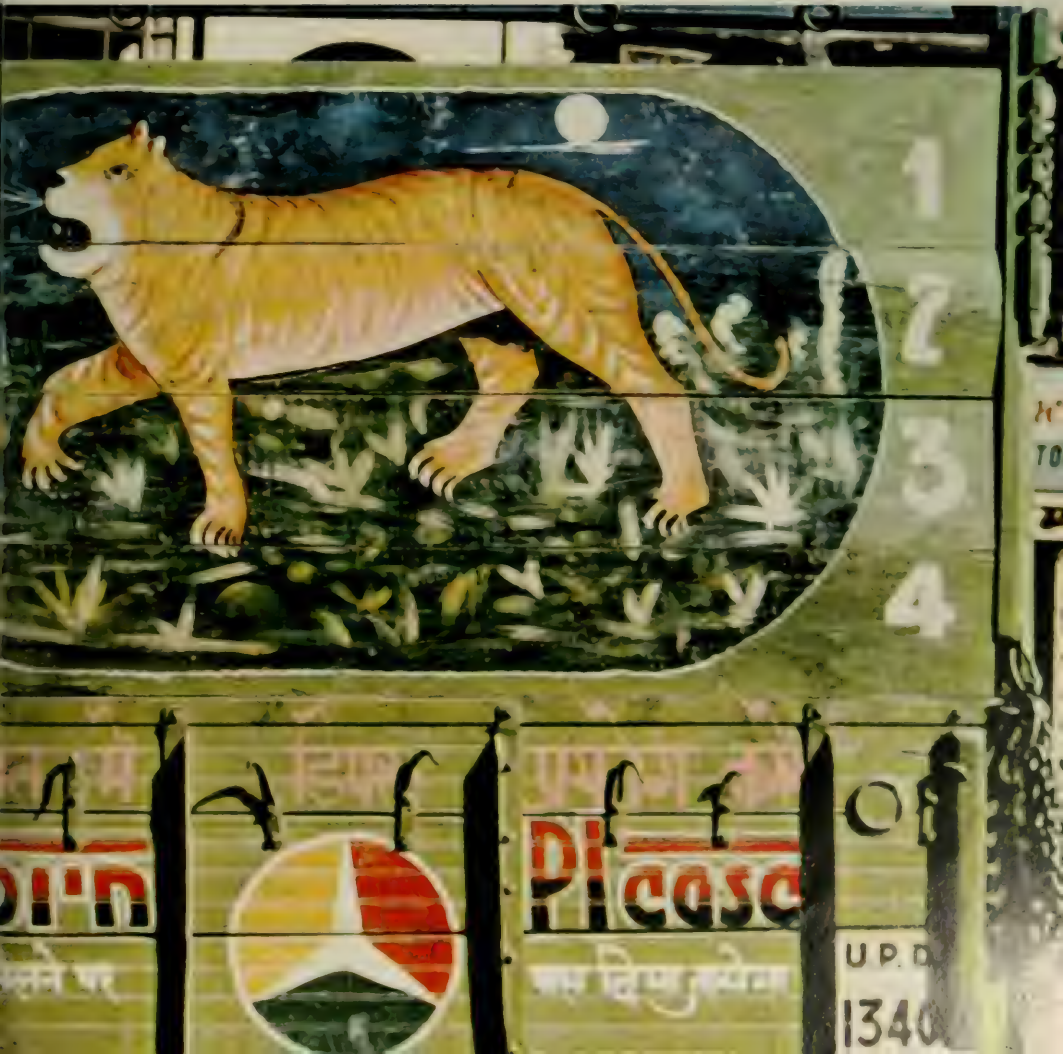


Even a truck tailgate can inspire a painting, its colors and figures infused with meanings that are carried throughout its travels.

Backgrounds are the freshly limed or mud- and w-dung-plastered surfaces of shrines, houses, stores, idges, and water fountains—almost any available ank space in the village. Sizes vary from quite small larger than life, and colors range from the more onochromatic effect in north-central India to the full e of brilliant color in west and east India. The rks may not outlast the next monsoon. But at least e strong rains make room on the walls for the next t of paintings.

Temples and shrines are frequently identified by the imal that each god traditionally rides. Thus lions or ers outside can mean the goddess Devi within, al- ough they are signs for the sun and moon as well. ound the entrance there may be sabered men on ancing horses accompanied by other guardians who help to defend the faith: these are often painted to celebrate weddings, as are hands holding flowers or object offerings to the god inside.

Where the signs and symbols used in village ceremonies and daily life came from, when they first appeared, or from what remote sources they came to be incorporated into folk art are unknown. They may have some connections with the manuals and Sanskrit code books dictating approved decorative patterns and drawing stylizations that are known to have existed during the Golden Age of the sixth to ninth centuries A.D. Many shapes suggest objects connected with the ancient Vedic and Tantric rites. If so, however, a great deal of their esoteric significance has been lost. What remains is an ongoing visual language, generally understood, but with variations from region to region.



The Barking Lizard

Vhen threatened, the tokay gecko arches its back, pens its pink and black maw, lunges forward, nd emits a piercing, doglike bark

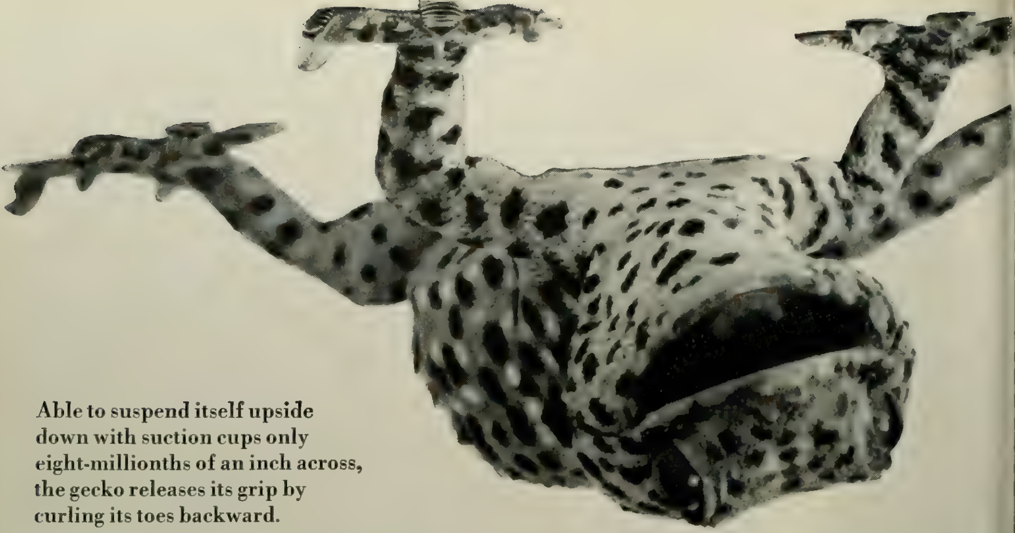
y Corson Hirschfeld

The "smiling" creature on these ges is a tokay gecko, a lizard re-arkable for its ability to climb rfaces as smooth as glass, its un-ual eyes and excellent vision, and s atypical doglike bark. The ckos are a cosmopolitan and cient family of more than 660 ecies that occur naturally all rough the warmer regions of the orld, on every continent (except ntarctica), on New Zealand, Mad-gascar, and many other oceanic lands.

Man's own peregrinations have ven furthered gecko distribution, r as inadvertent stowaways some pecies have been carried across the as to establish colonies in port ities around the globe. Of the four ecko species that inhabit Key West, Florida, for example, only one is a certain native, one may have been transported from Cuba, another was introduced from South America or southern Central America, and yet another is indigenous to the Middle East and the Mediterranean area. Indeed, geckos are one of the few reptiles to benefit from an association with man, whose habitations provide refuge and attract invertebrate and small vertebrate food. Consonant with folklore surrounding all reptiles, the inoffensive geckos are frequently represented as dangerously poisonous beasts to be scrupulously avoided, although the colorful tokay is regarded as an omen of good fortune in its Malaysian homeland.

Geckos are generally small nocturnal or twilight creatures, rather stout and of low profile, having a soft, loose skin, which may be studded with small, hard tubercles. Although some are garishly hued, they are more often a conservative gray or buff, and may be capable of limited color and shade change. Some species exhibit bizarre variations of tail form, and the common lizard trick of dropping the tail when it is seized, to occupy a predator while the lizard escapes to grow another, is widespread. Despite its striking showiness and size, the tokay gecko typifies the group. The largest of the geckos, it attains a length of fourteen inches.

As sunlight wanes in the tropics, the emergence of geckos waxes, and by evening the small lizards are of-



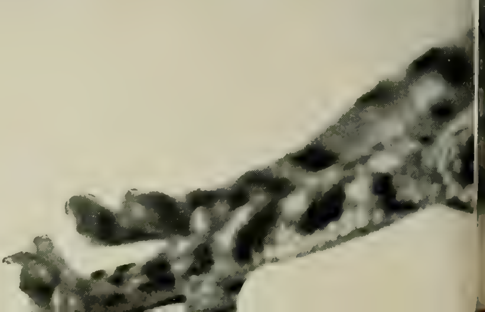
Able to suspend itself upside down with suction cups only eight-millionths of an inch across, the gecko releases its grip by curling its toes backward.

ten abundant in and around buildings—not on floors, but high on walls and ceilings where, awaiting prey attracted by the lights, they cling motionless, a short dash away from some protective crevice.

Nearly as surefooted as flies, most species can walk as positively up window glass as on rough stone. This ability derives from the structure of the gecko's toe pads. Drawing a finger outward across the underside of a tokay's foot, one first gains an impression of soft kid leather, then encounters a disturbing resistance, as if the toe pads were covered with congealing glue; yet they are clearly dry. While it has long been known that the gecko's climbing prowess is not due to stickiness, the responsible mechanism has been misunderstood. Beneath the tokay's toes are transverse parallel ridges of tissue, the lamellae, and within these are brushlike microscopic setae. Recent work (*see* Natural History, August, 1969) reveals that these setae branch again and again to eventually end in tiny cups less than eight-millionths of an inch in diameter that are presumably capable of suction. Because of their size and numbers, the cups conform to minute irregularities and are thus capable of far greater adhesive ability than grosser devices. The engagement and release of these structures is related to the angle at which they come into contact with, or leave, a surface.

Careful observation reveals that with every step the tokay gecko lifts each foot toe tips first. The toes curl up from the tips backward to form a reverse "fist," and the palm leaves the surface last. The fist is held until the palm again touches, the toes then curl back down until the tips touch last. Thus the clinging devices are released and engaged.

Geckos typically have well-devel-
oped vision, and some species ha
a high degree of binocularity, u
common in lizards. With few e
ceptions, geckos lack movable ey
lids. Instead, each of their usual
large eyes is covered with a har
clear, watchglass-like spectacle. Th
is apparently an adaptation to fee
ing in weak light, the spectac
affording protection as the lizar
brushes past dimly seen leaves an
other threats to eyes. (The simil
spectacle of snakes is considered
remnant of dubious current adva
tage carried over from burrowin
lizard ancestors.) Unable to blin
the gecko reveals one of its mo
curious habits if its vision is in
peded by water or detritus lodge
on a spectacle: it extends its flesh
tongue and simply wipes the e
clean. After a messy meal, it may
the same fashion cleanse the are
surrounding the mouth, an actio
that is strongly reminiscent of
preening cat.



While diurnal gecko species tend have round pupils, the irises of e nocturnal majority character- tically narrow to form the vertical upils typical of animals active in oor light. Somewhat paradoxically vertical pupil serves its possessor, ot in a weak, but in a strong light, it is more efficient in shutting the ght out and protecting an ex- emely sensitive retina. These ani- als are not blinded by bright light d many, such as basking geckos, ay remain active in direct sun- ght.

The tokay and related species ex- ibit a further unusual adaptation at makes for particularly excellent esight. The iris of the eye is bed, and when closed to a vertical it, the lobes form four pinholes, e images from each being super- nposed on the retina. The theo- tical benefits are severalfold. irst, light reaching the retina can more efficiently diminished until is all but extinguished, giving the zard a longer activity span. Second, the gecko gains acuity, as each pinhole serves to focus light independently of the lens. Further, more area is seen in sharp focus than would be attained from a single large opening admitting the same amount of light. Finally, the angle of the visual field (seen from four openings spaced circumferentially across the eyeball) is far greater than would be derived from a single, central pinhole, thus permitting a more circumspect vigil for predators or prey.

If the tokay gecko is threatened, it responds with an imposing display. Whirling toward the aggressor, the lizard maximizes the body area presented by lifting high from its usual belly-to-substrate position, arching its back, and opening its mouth to reveal a pink-rimmed, black-pigmented maw that heightens the aspect of ferocity. Simultaneously the tokay lunges forward several inches and emits a piercing, doglike bark. The big tokay is apt to stand its ground, and its bite can very well match its bark. However, the critical distance at which it is provoked into actual attack is small: it would seem an assailant would nearly have to touch the lizard to be bitten. Smaller geckos are virtually incapable of inflicting bites painful to man.

Most, if not all, geckos have voices, and while the vocalizations of few match the fortissimo of the tokay's cry, the little lizards stand conspicuously apart from their generally mute reptilian brethren. The adaptive value of the gecko voice, whether interspecifically defensive, intraspecifically territorial or sexual, or a combination, remains unclear. Whatever the functions, geckos contribute their share to the tropical night's sonorous concert. Listening to their chirps and squeaks, it seems appropriate that the very word *gecko* was coined in imitation of their voice, perhaps the most salient feature of this unusual group of lizards.

Unable to blink, a gecko uses its tongue to clean the watchglass-like spectacles that protect its large eyes.

Sky Reporter

Wood Alcohol in the Milky Way A cloud of alcohol millions of miles across has been discovered floating between the stars near the center of our galaxy. It is the lethal variety, known as methyl, or wood, alcohol, but it is only a few atoms away from the cocktail-party variety.

The rest of us may find it a bit mind boggling to contemplate a cloud of alcohol as big, say, as the solar system, but the scientists are excited, too. It looks more and more as though even some of the relatively complicated molecules necessary for life are present in the primordial clouds from which stars and planets condense.

Molecules of methyl alcohol contain one carbon, one oxygen, and four hydrogen atoms. Ethyl, or "sippin'," alcohol, has two carbon atoms and two extra hydrogen atoms. Discovered almost simultaneously with methyl alcohol, and by virtually the same people, was formic acid, which has one carbon, two oxygen, and two hydrogen atoms. Both were found in the general direction of the galactic center, in the constellation Sagittarius.

The methyl alcohol was detected in the same radio sources where formaldehyde had previously been found. In the laboratory, methyl alcohol is manufactured from formaldehyde by adding two hydrogen atoms. Since most interstellar gas is hydrogen, the new breed of astrochemists were not surprised to find methyl alcohol where formaldehyde and hydrogen are known to be present. They carefully add, however, that they do not know how the alcohol is formed in space.

Formic acid in space is exciting because it is a key substance in the evolution of biological molecules. If formic acid is floating free in space, it may indicate that amino acids and even proteins themselves are there as well.

The radio astronomers who found the methyl alcohol were John A. Ball, Carl A. Gottlieb, and A. E. Lilley of Harvard and Harrison E. Radford of the Smithsonian Astrophysical Observatory. Ball, Gottlieb, Radford, and B. Zuckerman of the University of Maryland discovered the formic acid. A report on the methyl alcohol is being prepared for *Astrophysical Journal Letters;* the formic acid was announced in *Circular* of the International Astronomical Union.

Hunting for Dead Pulsars The mystery of the pulsars is by no means solved, but the theorists are beginning to agree that whatever else, they probably have lifetimes on the order of three million years. Since the galaxy is believed to be something like ten billion years old, presumably most of the pulsars that eve existed are now dim hulks.

The thing about a pulsar, even when it stops puls ing, is that it is a most unusual object. Originally star hundreds of thousands of miles across, it has col lapsed in on itself to become a neutron star perhap ten miles across. Its matter is crushed into forms un known on earth.

The stuff of this star is very dense: a handful woul weigh a billion tons. This density produces a gra itational field so strong that it may be possible to un equivocally identify a dead pulsar; particles sucked i by the immense gravity of such an object would emi X-rays.

Such X-rays have been observed as continuous radi ation from the plane of our galaxy, the Milky Wa They are significantly stronger than the over-all X-ra background. The test will come when better X-ray de tectors are developed: nearby dead pulsars shoul show up as discrete sources of X-rays. Such object would be optically visible as low luminosity star looking like white dwarfs, but exhibiting "unnatural spectra.

The best guess today is that there are millions, pos sibly billions, of dead pulsars in the galaxy. Detectio of nearby ones would tell us a little more definitely.

The Eye As Cosmic-Ray Detector When Pan Am fi nally starts honoring its reservations for moon flight one of the things they will have to warn passenger about is Cherenkov radiation inside their eyeball Nothing to worry about, of course; it is just primar cosmic rays slamming into their retinas with energie measuring in the millions of electron volts.

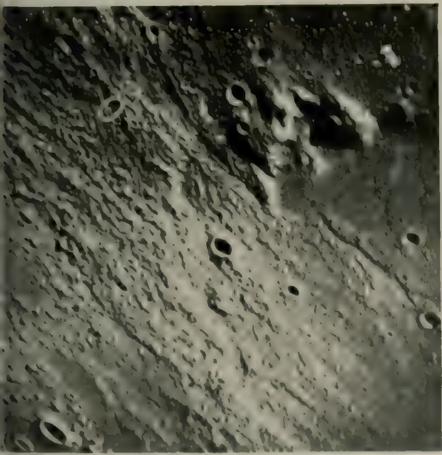
The results are not as horrendous as the proces sounds; the men who have made the trip say tha when they closed their eyes in the dark, they sa flashes of light as often as twice a minute. Apparentl no damage was done.

Cosmic rays are atomic nuclei, protons, electron or sometimes gamma rays, whistling through the ga axy at speeds near that of light. Primary cosmic ray are almost never detected at the earth's surface becaus they collide with air molecules high in the atmospher producing showers of secondary particles that cascad to the ground. All of us are being struck by such pa ticles all the time; a popular exhibit at science fairs i a detector that makes their passage audible or visibl

In space, apparently, the human eye can detect th more energetic primary cosmic rays. With the spac craft dark and his eyes closed, Neil Armstrong re ported seeing flashes at the rate of about one a minut z Aldrin reported pointlike flashes and occasional aks. Charles Conrad of Apollo 12 reported seeing ies with his eyes closed; about 10 percent of these e streaks. The Apollo 13 astronauts reported in r debriefing that they all saw the flashes, but only n they were relaxed.

he flashes may be the result of direct excitation of retina, but three men who have studied the phe-ienon and reported their results in the British jour- *Nature* lean toward Cherenkov radiation as the hanism. Cherenkov radiation is given off when a icle passes through a medium at a speed faster the speed of light in that medium. It is analogous he sonic boom made by aircraft traveling faster the speed of sound through the atmosphere.

iovanni G. Fazio of the Smithsonian Astrophysical ervatory and J. V. Jelley and W. N. Charman of Atomic Energy Research Establishment in Eng-l admit that either explanation could account for t of what the astronauts observed, but feel that the al descriptions best fitted the Cherenkov ex-iation. They suggest that by more careful observa- on future flights, the astronauts can make a final ision possible.



dot and oval mark the planned landing area for Apollo 14, scheduled launch at the end of January. The hilly, upland region is named for Fra Mauro crater, which lies to the south (out of the picture). As seen m earth, Fra Mauro is to the left and slightly below the center of the moon.

Or if we wait a little longer, and have a little extra vacation money, we can see for ourselves.

John P. Wiley, Jr.

Total Lunar Eclipse February 10 The February full moon will enter into total eclipse on February 10, as it passes almost centrally through the earth's shadow. The eclipse is of interest throughout the 48 conterminous states and Canada, where the entire event, from start to finish, will occur above the horizon.

Winter lunar eclipses, such as this one, have their good points and their bad. The winter moon is high, making for easy visibility and a bright moon clear of horizon haze, but that same height rules out any interesting combination views of moon and terrestrial scenes. Winter weather is tricky, but should a cold front pass shortly before the eclipse, exceptionally clear skies may follow. The converse, of course, is that nights when the viewing is best are not the most comfortable for man or camera.

Along the eastern seaboard, where the eclipse will begin shortly before 1:00 A.M., the eclipse will be an entirely after-midnight event. On the west coast, however, most of the eclipse will occur before midnight, with the end coming at about 1:30 A.M. About three and three-quarter hours will elapse from the time when the left edge of the moon first slides into the earth's shadow until, after having passed completely through it, the right edge finally emerges into sunlight again. The duration of totality, during which the entire moon is shadowed, will be about one hour and twenty-three minutes. The complete timetable:

Moon enters umbra (partial eclipse begins)	12:52 A.M., EST
Total eclipse begins	2:03 A.M.
Total eclipse ends	3:26 A.M.
Moon leaves umbra (partial eclipse ends)	4:37 A.M.

(Times are one hour earlier in each time zone to the west.)

Among the most interesting observations made during a long total lunar eclipse, such as this one, are the extent of darkening that takes place on the moon's surface and the change in temperature. Some residual sunlight penetrates the earth's shadow because of refraction by the earth's atmosphere, and this light falls on the surface of the eclipsed moon. The light is usually coppery red in color. But for reasons not well understood, the intensity of light seems to vary within the shadow and to vary from eclipse to eclipse. Rapid temperature changes occur on the moon during the eclipse, giving certain clues to the structure of the lunar surface.

Thomas D. Nicholson

Celestial Events

At mid-January the waning moon is a morning object. Last-quarter is on January 19, new moon on the 26th. Thereafter the moon is waxing and becomes an evening object. First-quarter is on February 2, and full moon on the 10th, when the moon again enters the morning sky.

From mid-January to mid-February, all the planets but one are in the morning sky, including the three telescopic planets, Uranus, Neptune, and Pluto. The exception is Saturn, bright among the dim stars of Aries, well up in the south during evening twilight, setting at about midnight.

Venus, Mars, and Jupiter have been distinguished morning stars since the beginning of the year. While both Venus and Jupiter are past their peak in brightness as morning objects, all three are becoming more prominent, rising earlier and appearing higher at dawn. Distances between them and relative positions vary so much that brightness and color are the best guides to identification. Venus, always the lowest, is by far the brightest. Mars and Jupiter are quite close and switch places at their conjunction on January 25. But the red or reddish yellow color of Mars distinguishes it easily from the whiter and brighter Jupiter.

Mercury becomes a respectable morning star from mid- to late-January, as it goes through greatest western elongation. Always below and to the left of Venus, Mercury can be seen in the early dawn a little to the south of east, brighter than Mars or Jupiter, although much less brilliant than Venus.

January 15: The reddish star to the right and below Venus is Antares, in Scorpius. Do not confuse it with Mars, similar in brightness and color, but above and to the right of Venus and very close to Jupiter.

January 18: Mercury reaches greatest elongation (24 degrees west of the sun) in the morning sky. A moderately favorable elongation, the planet is placed low in the dawn sky toward the east southeast. It should be visible from the 15th to month's end.

January 20: Only about 36 hours after Mercury, Venus also reaches its greatest elongation west of the sun. At dawn, the planet is 47 degrees to the right of the sun, well up in the southeast and easily visible as a morning star.

January 22-25: If morning skies are clear, do not fail to look at the waning crescent moon in the southeast, with Mars and Jupiter above it, Venus well to the left and below it. Watch the moon from morning to morning, waning and changing its position among the moving planets.

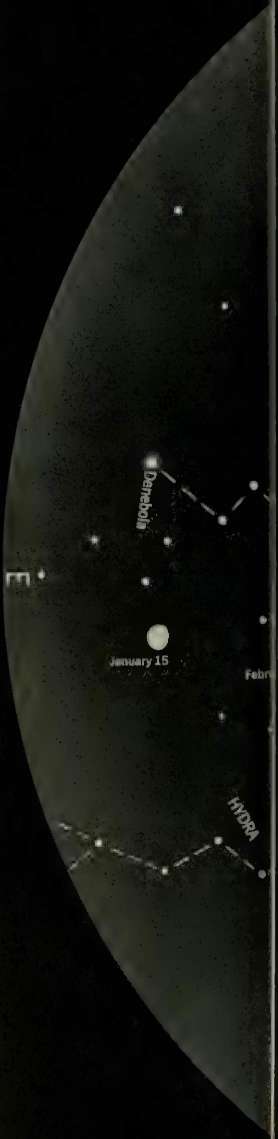
January 26: Mars and Jupiter have been slowly getting closer to one another. They are nearest this morning, and now begin to separate with Mars moving left of the more distant planet.

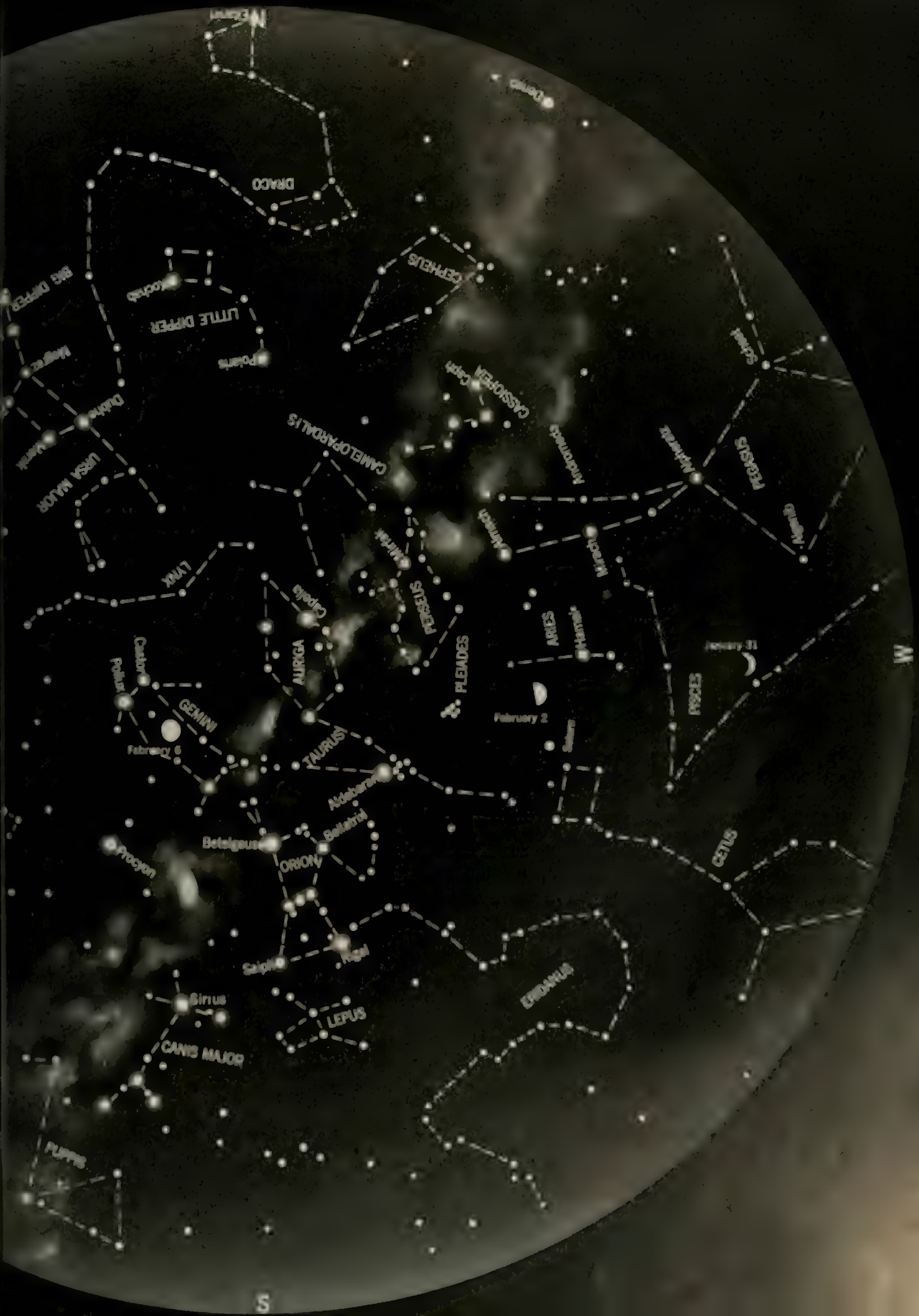
February 5: Mars is near Antares, the bright red star in Scorpius, so nearly like Mars in appearance. Mars is the upper of the two, and moves left of Antares after this morning.

February 10: Total lunar eclipse (see page 65).

Thomas D. Nicholson

★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky. The map is for 11:20 p.m. on January 15; 10:15 p.m. on January 31; and 9:15 p.m. on February 15; but it can be used for about an hour before and after those times.




N
Vega
DRACO
BIG DIPPER
Kochab
LITTLE DIPPER
Polaris
Megrez
Dubhe
Merak
URSA MAJOR
CEPHEUS
Caph
CASSIOPEIA
Deneb
CAMELOPARDALIS
Andromeda
Alpheratz
PEGASUS
Algenib
Mirfak
Almach
Mirach
PERSEUS
LYNX
Capella
AURIGA
Castor
Pollux
GEMINI
February 6
PLEIADES
ARIES
Hamal
January 31
February 2
PISCES
Saturn
W
TAURUS
Aldebaran
Bellatrix
Betelgeuse
ORION
Procyon
CETUS
Rigel
Saiph
ERIDANUS
Sirius
LEPUS
CANIS MAJOR
PUPPIS
S

Can Leviathan Long Endure So Wide a Chase?

Continued from page 40

versity of Washington, have in recent years chaired the commission's two principal committees, the Technical (McHugh) and the Scientific (Chapman).

In addition, the United States is a major importer of whale oil and whale products, making up roughly one-fifth of the world market. Hopefully this market may be closed if the whales can be kept on the endangered species list published by the Department of the Interior. Whatever the use of whale products, whether for lipsticks or lubricants, a satisfactory substitute is available in every instance.

1. On the matter of quotas, the Scientific Committee annually recommends that the blue-whale unit be eliminated. Under this curious and anachronistic arrangement one blue-whale unit is equal to one blue whale or two finbacks or two and a half humpbacks or six sei whales. Because it did not specify which whales may be taken, the blue-whale unit contributed to the collapse of the antarctic fishery. Again this year the commission stuck by the invidious blue-whale unit in the Antarctic; in fact, the commissioners did not even raise the subject. The Scientific Committee (with the exception of the Japanese scientists) generally concurred that the sustainable yield for next season was 2,600 finbacks and 5,000 sei whales. The commission set a quota of 2,700 blue-whale units, which works out to be 27 percent more than that recommended by the Scientific Committee. Even recognizing that Norway will probably not take the 200 units assigned to her, the quota does not allow any margin for the stocks to recover and probably will cause further depletion.

In the North Pacific, the Scientific Committee's studies revealed that the sustainable yield is 1,300 finbacks and 3,100 sei whales. The commission set quotas of 1,308 for the finbacks and 4,710 for the seis. Worst of all, a fudge factor of 10 percent—reminiscent of the blue-whale unit—was built into these numbers, so that whatever the whalers fail to catch of one species they can take in the other.

2. Regarding the sperm whale, the collapse of the antarctic fishery and the strain on the baleen whales in the North Pacific has meant that the damage inflicted on sperm-whale stocks—so far without any quota whatsoever from the commission—has been intensified e year. For more than twenty ye the number of sperm bulls cau in the Antarctic has ranged betw 2,500 and 7,000 annually, w higher numbers killed earlier

The following great whales are ranked by their degree of rarity. The first group is protected. The second group is still hunted, but the herds are rapidly being depleted. Population figures are rough estimates.

Bowhead	Double spout, great curved jaw, bonnet; Eskimo still take a few every May; its numbers estimated at no more than a couple of dozen.
Right Whales	(2 species), so called because they were the "right" ones to kill in the nineteenth century; slow swimmers that floated after being harpooned; double spout, curved jaw, bonnet, barnacles; its numbers may be measured in dozens in a few remote areas.
Blue	Largest animal on earth, splotchy exterior, weighs as much as 1,500 men; its numbers have dropped from perhaps 100,000 fifty years ago to fewer than 1,000.
Humpback	Most boisterous, breaches frequently, long flippers, unexplained knobs on head, great singer; less abundant originally than the blue, its numbers today are down to a few thousand.
Gray	Small rorqual, Korean stock not seen in years; following 30 years protection, the California stock has slowly recovered and now numbers 10,000-12,000.
Finback	Second largest of the baleen whales, fast swimmer, asymmetrical white marking on underside that overlaps right side of jaw; its numbers are estimated at about 100,000 today against about 400,000 formerly.
Sei	Third largest baleen whale, six times smaller than blue in terms of oil yield, its smaller, less numerous cousin Bryde's whale is also pursued; its members are at least one-half of what they were, 75,000 compared with perhaps 150,000.
Sperm	Only great toothed whale, square headed, corrugated body, harem groupings, diagonal spout, squid-eater, deep diver, found in all the oceans; most abundant species but its numbers are down to perhaps 250,000 from an estimated 600,000.

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lower numbers recently. For example, the peak was fifteen years ago when 6,974 sperm whales were reported taken, a catch that produced 342,000 barrels of sperm oil. During the 1969–70 season, 3,090 sperms were taken in the Antarctic for a production of 125,000 barrels of oil. The striking fact about these figures is that they reflect a steady decline in the yield in barrels of oil per whale over the past fifteen years. The oil yield in the Antarctic has dropped alarmingly, from 49 barrels per sperm whale to 40 barrels. In a mere fifteen years the sperm whales are 18 percent smaller. The pattern of predation seems intractable.

The ecology for male and female sperm whales differs markedly. While the males attain lengths of 50 to 55 feet and more, the females are mature at 35 to 40 feet; indeed, females shorter than 38 feet in length are "protected" from pelagic whaling, while those less than 35 feet are protected from land station whaling. The catch data piles up at these minimum legal lengths lending credence to the general belief that the infractions are many and blatant.

An analysis and estimate of the sustainable or potential yield of the sperm whale in the North Pacific has been made by three Japanese scientists. They estimate the present sustainable yield of male sperm whales in the North Pacific at 4,290. The catch the past two years has been 12,740 and 11,329. The Japanese scientists say that "this male sperm whale stock has . . . little or no further surplus." The population has been driven to a level of about one-half of its unexploited state. Privately, the North Pacific commissioners agreed to a catch 10 percent below last year's. This catch limit—set provisionally behind closed doors outside of the formal business of the commission—is 240 percent of the sustainable yield estimated by the Japanese scientists. The pattern of predation is familiar—as is the capacity of the International Whaling Commission to look the other way when the chips are down.

3. The most important single item on the agenda, the International Observer Scheme (IOS), was discussed at length. It was ap-

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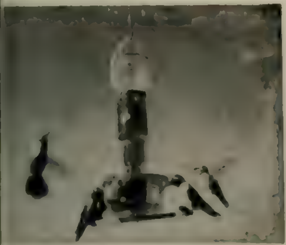

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proved in principle seven years ago and has been piously reaffirmed annually. But no effective steps have been taken to implement it.

At the meeting, Dr. McHugh stated that the commission's inability to implement an observer scheme weakens it as a conservation organization because it seems to lack the ability to enforce its regulations and quotas. The Japanese commissioner, Mr. Fujita, said that his country would support the implementation of the observer scheme for the next antarctic season and felt that the plan should extend to land stations as well.

The Soviet commissioner, Mr. M. N. Sukhoruchenko, said that the IOS could be used at present with some small changes. He urged that two persistent problems be settled: every country has an obligation to send observers as well as receive them; the IOS will be effective only if implemented both for land stations and pelagic operations. He recommended that the commissioners meet on and settle this matter prior to the 23rd meeting in June, 1971, in Washington.

Mr. Fujita said that there was no basic disagreement on implementation, but that the commission did not have time to pursue the matter further.

All these words sound reassuring, but the IOS is still not implemented. A possibility exists that the United States and Japan may work out some modest form of exchange for their land stations that could serve as a model for other countries next year.

A beginning may yet be made. It is crucial to know when a protected species is taken and labeled something else; as, for example, when an immature blue whale, unmistakable because of its splotchy exterior, is harpooned and listed in the day's log as a finback.

Another example of the most egregious sort of violation of the regulations took place in the 1962-63 season when a factory ship and its catchers swept in on a small colony of "protected" right whales near the island of Tristan da Cunha in the South Atlantic. The few dozen rights, the largest grouping that had been seen in any ocean in years, was completely wiped out. This well-known incident has never

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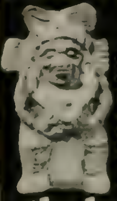

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been aired at the International Whaling Commission meetings nor has it appeared in print, but it is a tragic example of what happens in the absence of an International Observer Scheme. And there are many other unreported tragedies. Just talk to the whalers.

4. The meeting of the International Whaling Commission barely touched on the U.S. Department of the Interior's bold action in placing all the great whale species on the endangered species list of June 2, 1970, implementing the Endangered Species Conservation Act of 1969. According to the provisions of the act, no species that is demonstrated to be threatened with extinction may be imported, alive or dead, whole or in part, into this country. By placing baleen whales, as well as the sperm whale, on the list the Department of the Interior went beyond the mere protection of species already struggling for survival. With the threat of economic boycott, perhaps the member nations of the International Whaling Commission will be spurred to take their task more seriously.

Until last November, a big question remained as to the chances of all these species remaining on the list. The sperm whale was especially vulnerable. Interior Secretary Walter J. Hickel was under great pressure from whale oil importers, from other departments within the government, and from overseas to drop the sperm whale from the list. On November 24, 1970, after six month's intensive review, Secretary Hickel affirmed that all eight threatened species of great whales will be kept on the list and banned from importation to "prevent conditions that lead to extinction."

Explaining why the department kept the fin, sei, and sperm whales on the list, Hickel said it is "clear that if the present rate of commercial exploitation continues unchecked, these three species will become as rare as the other five." He also called for a conference, jointly sponsored by the Department of the Interior and the Smithsonian Institution, to be held early this year to review what can be done to restore whale populations in the oceans of the world.

The Secretary omitted mention of one aspect crucial to any effort to save whales: funding. Scientific programs to monitor the size of the whale herds and the United States share of an observer scheme both need financial support.

This break for the threatened whales was accompanied by some good news from Japan. Last August I went there on behalf of the Environmental Defense Fund and the New York Zoological Society, to discuss with Japanese scientists the initiation of a campaign to save whales. The scientists have formed a Committee for the Protection of Whales, chaired by Dr. Seiji Kaya. Along with writers Kenzaburo Oe and Sakyo Komatsu, they have taken the whale problem to the public for the first time. They are urging the Japanese government to curb the whaling industry and to strengthen the powers of the International Whaling Commission.

The big question remaining is the Soviet Union, but we have prospects of positive developments there, too. The problem of the survival and continuity of the great whales would be eased if the Soviets extended to large whales the attitude they take toward the smaller dolphins and porpoises. In March, 1966, the Soviet government banned the catching and killing of dolphins. This decision was taken, according to Alexander Ishkov, Soviet Minister of Fisheries, because research has shown that dolphins have brains "strikingly close to our own." Dr. Ishkov, therefore, regards the dolphin as the "marine brother of man," noting, "I think that it will be possible to preserve dolphins for the sake of science. Their catch should be discontinued in all seas and oceans of the world."

May the song of the humpback whale soon sound in the Bolshoi Opera House.

We know very little about whales. Until a few months ago, for instance, we did not know that some whales sing, and that these songs make a profound impressi on the human listener.

What we have seen closely whales to date—and watched wi strange fascination—are "dea flurries," the tragic scene that h played to an inert, bloated co clusion 60,000 times a year f eight years (1958 to 1965) ar now is down to 40,000 times a yea Today, a whale is harpooned eve 12 minutes on the average. T "life flurries" remain essentially u known because no man has stay with a whale pod hour after hou day and night, week after week.

Melville concluded:

"Dissect him how I may, then. but go skin deep; I know him n and never will. But if I know r even the tail of this whale, how u derstand his head? much mo how comprehend his face, wh face he has none? Thou shalt my back parts, my tail, he seems say, but my face shall not be see But I cannot completely make his back parts; and hint what will about his face, I say again has no face."

As a species, man is at a point his own evolution where he cann yet create a flea but is wholly pable of destroying the whale. T job is three-quarters complet when measured by the great wh species that are threatened with tinction.

Our survival is curiously int twined with that of the whale. J as all human life is interconnect (in the Monkey-Rope situation *Moby Dick*, Ishmael declares, saw that this situation of mine w the precise situation of every m tal that breathes; only, in m cases, he, one way or other, has t Siamese connexion with a plural of other mortals. . . ."), so ha we finally begun to perceive the c nections between all living thin The form of our survival, inde our survival itself, is affected as variety and abundance of life is minished. To leave the ocea which girdle seven-tenths of world, barren of whales is as thinkable as taking all music aw and everything associated with m sic—composers and their wor musicians and their instruments leaving man to stumble on w only the dryness of his own mutt ings to mark his way.

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"We Wish More and More That She W

An anthropologist's trauma among the Eskimo

NEVER IN ANGER, by Jean L. Briggs. *Harvard University Press, $15.25; 379 pp., illus.*

A childhood wish to know what it felt like to be an Eskimo and the practical need to gather data for a dissertation in anthropology brought Jean L. Briggs to a tiny all-Eskimo settlement at the mouth of the Back River north of the Arctic Circle in central Canada, in August, 1963. As she stood listening to the fading noise of the departing plane, surrounded by Eskimo whom she had never before seen and whose language she could not speak, she first felt that peculiar sense of rootlessness and lack of context that anthropologists call culture shock. Yet she expected to have no particular difficulties, for she had never felt herself very American in outlook and rather hoped to discover that she was essentially Eskimo at heart. She would first "learn the language" and "develop rapport" and then undertake her planned investigation, the study of the social relationships of shamans.

Things did not work out as she had planned. The group that she had chosen to visit had no shamans, a fact that she did not discover until long after her arrival. Learning the Eskimo language proved to be difficult and frustrating, and during the first year of her 18-month stay at Back River, she was largely confined to recording those aspects of life that were tangible and visible. When she finally began to develop enough linguistic competence to ask questions with some hope of being able to understand the answers, a serious misunderstanding arose between the Eskimo and her that resulted in her being ostracized for about three months. During this period, her linguistic powers declined spectacularly. In November she and the Eskimo were reconciled, and in January she left Back River. As for discovering that she was "essentially Eskimo at heart," she found that in at least one critical way she was the antithesis of the Eskimo: she possessed a volatile temper; and among people who highly value self-control and kindness, this characteristic was nearly her undoing.

Because everything went wrong, one might be tempted to say that Briggs had failed. Yet she succeeded magnificently. Abandoning her original project, she concentrated upon the aspect of Eskimo life most accessible for study, namely, the emotional relations that the members of the Eskimo family who had adopted her, and with whom she lived, maintained among themselves and with outsiders; and her principal disadvantage, her non-Eskimo emotional volatility, she turned into a major asset as she analyzed much of the Eskimo's personality and emotional expression in terms of their reactions and adjustments to her. The result is a thoroughly candid account of an anthropological field experience: of what it means to try to adjust to a social situation in which, initially at least, one is unsure of what constitutes proper behavior; to be constantly alert to censor actions that in one's own society are largely unconscious in order to avoid offending the partially understood sensibilities of one's hosts; to fight down the hysterical terror of starving or freezing to death in an environment where one is helpless and utterly dependent upon one's hosts; to avoid letting small mishaps assume mountainous proportions in one's imagination;
to make the one adjustment tha
Western anthropologists find so
cult—learning to live with an al
total lack of privacy.

Following an introduction
recounts the events leading to
arrival at Back River and gives s
miscellaneous information on the
kimo, Briggs describes in sev
chapters the emotional relations
among the people that she knew
concentrating, initially, upon her
family. These chapters include s
excellent descriptions of child-rea
practices. This is followed by a
appendix discussing various Esk
emotional concepts and by a
short appendixes containing g
alogical information and glossa

The heart of the book is the
chapter entitled "Kapluna [wh
Daughter." In it, she describes
principal phases of her relations
the Eskimo: their initial gracious
and her early struggles to adjust;
covert conflicts of family living
finally developed into open confli
her angry confrontation with s
white sportsmen, which so distur
her Eskimo hosts that they ostraci
her; and, finally, the reconciliation
the Eskimo and their white daugh
Her realization of how the Esk
really regarded her came only w
she surreptitiously read a letter t
one of them had asked her to k
until the plane came. "[Briggs] i
liar. She lied to the [whites].
gets angry very easily. She ought

Eskimo child i
anthrop
by playing re

ave”

to be here studying Eskimo. She is very annoying because she scolds and one is tempted to scold her. She gets angry easily. Because she is so annoying, we wish more and more that she would leave.”

In the end, it was the Eskimo who saved the situation. One of them found a way to explain the incident with the white fishermen, and the social ostracism of Briggs was at an end. One cannot read Briggs' account without marveling at the patience, good humor, and understanding of her Eskimo hosts. They were unfailingly kind and considerate, even when she was ostracized. The inconvenience she caused them must have been enormous, yet they very rarely showed her any annoyance. And beyond caring for her as a child, they patiently answered her questions to see that her scientific work was successful. Few other anthropologists have described as well as Briggs the intimate and complex relationships between anthropologist and host; and few have managed to capture the personalities of their hosts as well as she. Her portrait of her adopted father, Inuttiaq, is a masterpiece, and her discussions of her relations with him reveal with considerable insight both differences between Eskimo and white cultures and the clash of two strong-minded individuals. Although Briggs justifiably worried about the effects on the Eskimo of some of her less attractive personality traits (and she mentions only unfavorable ones), the Eskimo saw other qualities as well. “[We] didn't think [we'd] care when you left,” wrote Inuttiaq and his wife some time after Briggs had left Back River, “but [we] did.”

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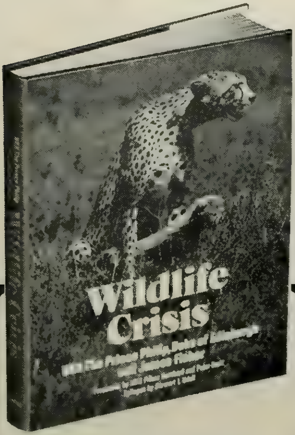

by H.R.H. The Prince Philip, Duke of Edinburgh, and James Fisher

Forewords by
H.R.H. PRINCE BERNHARD
and PETER SCOTT
Epilogue by STEWART L. UDALL

For the first time, Prince Philip writes of his personal philosophy and involvement in wildlife conservation. Articulate, witty, and refreshingly outspoken, his account is highlighted by his own superb photos. James Fisher, the distinguished naturalist, provides a fascinating, comprehensive history of man's impact on the world's creatures and the organized movement to save them. Written with the full cooperation of the World Wildlife Fund, this outstanding work is without peer. "A beautiful book!"—The Conservation Foundation. Illus. in full color and b&w.

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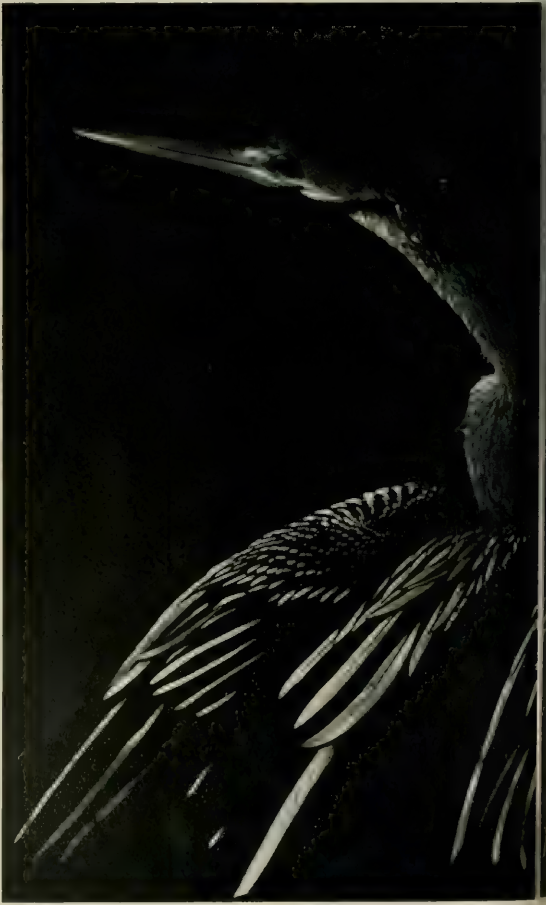
The Everglade

by Claude R. Kirk, Jr.

The former governor of Florida takes "equal time" to present another side of the environmental coin



GLADES, by Patricia Caulfield. *a Club Books, $27.50; 143 pp.,*
.

are on an early morning flight ver south Florida.

rst light is beginning to touch Miami Beach-Miami skyline. Soft gleams from scores of high-rise lings housing thousands of le. Thousands of headlights leave trails of light along hundreds of of expressways, feeder high- . and downtown streets. Traffic flick through green-yellow-red , grouping the moving lights clots of traffic.

e of the nation's great urban is beginning to awaken. People, ands and thousands of them, are e move. We can almost hear the roar of traffic, the hundreds of ds of an awakening city. It is im- sive.

rst light moves slowly south and dully illuminating wisps of nd fog lying low over a flat plain ching far into darkness. Patches ater shine metallic-blue through lowly rising vapor. It is as if we lying into the dawn of the earth's day. Nothing moves but the light is dawn. It is impressive.

ith a turn of the head, we can l from civilization to prehistory. can see the good and the bad of 's highly mechanized new urban life style, and we can see one of the last areas of its kind left to us today—a model of prehistory and the dawn of a world untouched by man.

Everglades, by Patricia Caulfield, published by the prestigious Sierra Club, beautifully tells the story of one of the views we have seen. Her photographs show the brooding, mystical beauty of a landscape that must be preserved.

But it remains for the two maps at the beginning of this book to tell the story of what has happened to the southernmost tip of Florida. In a "before and after" sequence, the maps show the Everglades and Lake Okeechobee areas as they were before man intruded in sizable numbers. The map depicting "works of man" shows the great coastal strip of cities and the tremendous pressure people bring upon an environment. If there is a lack in this account of one of the world's most fascinating areas, it is this single-sided view of an ecology complicated by man's many demands.

It is ironic that without man pressing in upon the Everglades, there would have been no need for the Everglades National Park. Without the highways and accommodations for man, there would be no way hundreds of thousands of Americans could view this last frontier of the earth's beginning. And this is where my quarrel comes with the author.

Through selected protagonists she rightly shows that the Everglades area is endangered by growth. We are told by one protagonist that people will destroy the Everglades. We are told by another how he slaughtered the animals of the Everglades and

ater-turkey, or anhinga, underwater, spearing fish s slender bill.

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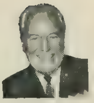

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now wants to recant and become a protector of the park. We are told of the dangers facing the Everglades National Park due to man's encroachment. The dangers are real, but man is becoming an endangered species too.

I once told a group of friends who are—as am I—conservationists, that if forced, as governor of Florida, to choose between the deer of the Everglades and man, I would have to choose man. This seems a rather simplistic point of view, but it roused considerable ire at the time. This does not mean that I consider the preservation of a species of no great concern. It does mean that I consider the preservation of humanity of first priority. Enlightened mankind can save the rest.

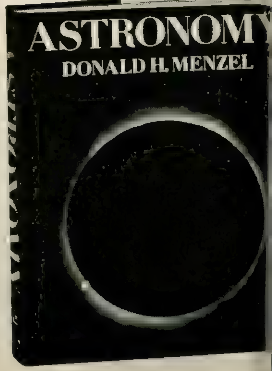
Patricia Caulfield arrives at an oversimplified conclusion as to how the Everglades can be saved—increase the landholdings, decrease the growth of Florida. By the use of this theory, all of the endangered natural areas of our nation can be preserved—but for whom?

And what growth shall we limit? We calculate that there are 2,000 new families moving into Florida each week. Is this the growth we should stop? Because we have an increasing population, we have a rising number of births. Is this the growth we must stop? More than 20 million Americans visited Florida last year and many of them saw the Everglades National Park. Is this the growth we must stop?

The author argues that because of the sins of the past, the Everglades is in real and present danger. Does this mean that we should reduce the population of the coastal cities to ease the pressure upon the ecology? Where do we move these people? Wherever they go they will need water, they will need support services, they will need transportation, housing, and industry or business to supply them with paychecks.

I don't want to belabor the point. But it is dangerous to oversimplify solutions because in so doing, you oversimplify the problems. It is dangerous to equate all growth with destruction of natural resources.

In the last four years Florida has come a long way in the area of conservation. *Everglades* is a fair account of the past—of the Army Corps of Engineers and its levees, dikes, and fantastic regard for channelization as a solution to all problems of water movement and conservation. The author tells of the Southwest Florida Flood Control District and its regard for the growers who need impound-



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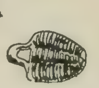

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ments and regulated water flows. These are illnesses inherited from a time when man was unconcerned with preserving nature and uncomprehending as to the future tremendous growth of Florida.

I don't know how much of what has been done is irreversible, or how much can be adapted to our present concerns. I do know that it is highly unfair to call the new "doctors" trying to cure these inherited illnesses quacks because of the record of the past. Give them a chance. Florida has been the victim of the spoilers and this has left us with examples of man's rapacity, greed, and lack of concern for those who will live after him.

Florida is also the victim of a cabinet system. Six elected officials sit as the cabinet. The governor is a member and as such, has one vote on matters coming before this group. Before I took office four years ago, it was the practice of this cabinet to meet each Tuesday and to consistently "sell" submerged land areas to developers at ridiculously low prices. There was no requirement for the preservation of any natural area. And so, thousands of acres of invaluable coastal marshlands fell into the hands of speculators and developers. We have stopped this. But is it too late? Time will tell.

Early last year, we purchased Payne's Prairie—17,200 acres of marshland that is interspersed with hardwood-forested high land. It is a significant breeding area still largely in a wild state. It is the last major wintering ground of the endangered greater sandhill crane. Near Gainesville, it is surrounded by areas destined to become highly urbanized. Were we too late? Time will tell.

I feel that in fairness I must explain what Florida is doing. My posture is not defensive, it is one of sharing knowledge. *Everglades* has told one side of a story. Let me touch on the other side.

In October, we urged rejection of any further oil exploration in the Big Cypress Swamp adjoining the Everglades National Park. This watershed area, as outlined in *Everglades*, is vital to the Everglades. We feared that exploratory drilling would cause oil pollution. At that time we noted that when oil spoils our beaches we can turn the sand and clean it, but how do you clean a marsh and save the animals? The answer is you don't.

Most of America is familiar with the Florida jetport controversy. A coalition of conservationists and a concerned executive branch of state government won a major victory in stopping the projected use of the area. I have taken the position th there is room for both man's need f air transportation and for the pre ervation of natural wilderness areas Florida.

In October, in a sentimental reu ion, I met with my conservationists, n eagles, at an awards luncheon. I spol briefly of Florida's concern with t present, as well as of its plans for t future. Allow me to quote from th talk:

"We have begun to win battles, b the war is yet to be won. Those of who firmly believe that environmen quality is our birthright, not a pri lege, must stand united or our st will begin an accelerated nose d toward a polluted quagmire.

"This administration has not sw bad news under the table. We h faced the facts.

"We have had three difficult s sons in managing the Everglades, have continuing fish kills in Escam Bay. We have faced the issue of th mal polluton and the jetport. have developed solutions to La Toho and Apopka.

"I have appointed the best F and Game Commission, Pollut Control Board, flood control boa of any administration.

"I am proud of that record and not afraid to say so. This has been administration that has appointed finest people to its advisory board have never, not once, asked any bo or member of any board to fol any other course than that which honest and right.

"There have been no politics in conservation record of this admi tration. We have scaled mountain we have soared like eagles. Wo you have believed Biscayne Nati Monument, or Payne's Prairie, or St. Lucie State Park, or the up reach of the Loxahatchee?"

These were all triumphs of d cated, concerned people and some someone like Patricia Caul should tell their story.

There is, however, much to be d and I leave these challenges to t who follow:

We must bring back to the pu the submerged lands so waste and ignorantly sold to specula We must preserve the Big Cyp Swamp area. We must save I Okeechobee from a green algal d We must not proceed on the C Florida Barge Canal until our kn edge matches our technical abili move dirt. We must clean up th Johns and Miami rivers. We save St. Lucie and Tampa bays.

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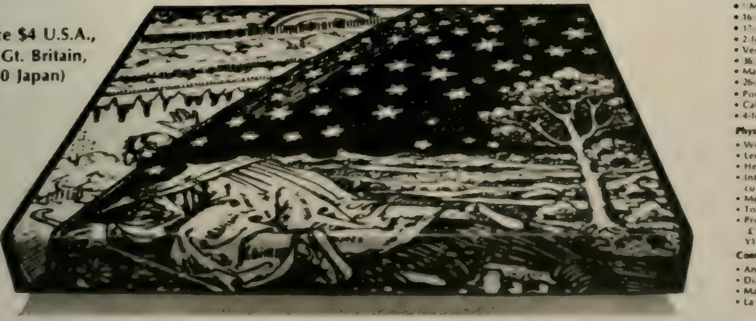

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- Mandala music score (8⅓ inches, 40 "bars")
- 26-inch triptych of hand crafted grotesques
- Portfolio of Fluorescent Paintings
- Calligraphy Booklet (uncut) w/ text
- 4-foot "frieze" of Universal Mutant Photos

Physical Dimensions

- Width: 9⅔ in
- Length: 12⅔ in
- Height: 1 inch
- Interior: 118.25 cu. in.
- Media Formats: 10
- Total Items: 14
- Price: $4 U.S.A. £1 14s Gt. Britain ¥1440 Japan

Contributors

- Angus MacLise
- Diane Rochlin
- Marian Zazeela
- La Monte Young
- Ira Cohen
- Bill Devore
- Don Snyder
- Terry Riley
- Gerard Malanga
- John Cale
- Paoli Lionni
- Mikki Grand
- Harvey Cohen
- Lionel Ziprin
- Tom Carroll
- Dale Wilbourne
- Benno Friedman
- Aymon de Sales
- Christopher Tree
- Hetty MacLise

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ecord side 1: Christopher Tree's *Spontaneous* d. Incredible *ad libitum* performance by one on 150 exotic instruments: drums, gongs, s, reeds, Tibetan temple horn, etc. ecord side 2: "The Joyous Lake." Fantasmacal (and previously unexplored) combinations ock, electronic and environmental sound

onicle of the Knowers": sensuous gallery of rescent Paintings by Hetty MacLise, erstwhile gist of the San Francisco Oracle

minated triptych (opens to 2 16 feet) of Mayan ical scores and glyphs by Aymon de Sales

ns of a 20th Century Nature Priestess": Diane hlin's pungent 792 sq. inch (3 phase) photo tage created on farm near Positano, Italy

l of the World": intricate Calligraphy Book printed in Japan (opens to ⅔ yard, uncut) by light/sound sculptress Marian Zazeela.

inch poetic exposition of "Dream Music" by Monte Young, one of America's most advenus composers

squieting 4-foot "frieze" of Universal Mu Photographs (in color) by Ira Cohen

- A vertical diptych of the Illuminated Magics of GOERALEGAN (al *neis purnaakö eibelis teolknenent*) suitable for framing
- 36 psychedelic nudes projected as full color postage stamps by Don Snyder, mixed media alchemist.
- Mandala music score by virtuoso Terry Riley.
- 12-section (648 sq. inches—please unfold carefully!) photo-poetry poster by Gerard Malanga, Byronesque film-maker/poet in leathers; John Cale, high priest of Rhapsodic Cynicism; Paoli Lionni, *et alii*
- 17-inch vertical fold-out of opening 24 pages from "Sentential Metaphrastic," an 1100-page work-in progress by Lionel Ziprin of the East 7th St. labyrinth.
- 16-page portfolio of chemically stained classic Western movie frames by Benno Friedman

SOME ASPEN CONTRIBUTORS

nel Trilling	Alain Robbe Grillet
anuts Hucko	Susan Sontag
ysles Brothers	Samuel Beckett
n Renoir	William Burroughs
Karl Menninger	Moholy Nagy
dy Warhol	Marcel Duchamp
llem de Kooning	Confucius, Guatama Buddha, and numerous Zen priests (names on request)
nothy Leary	
rshall McLuhan	
hn Cage	Buckminster Fuller
ckroach	and many more

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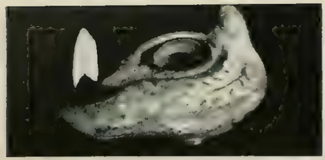

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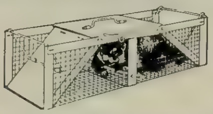

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research is studied and considered.

This may seem somewhat far afield in a book review, but I believe the thoughtful reader of *Everglades* will be much more knowledgeable after viewing the other side of Florida's ecological coin.

And, while it is not part of the book, I am disturbed by the advertising copy in NATURAL HISTORY urging readers to buy *Everglades:* "How to Secede from the Union Without Really Trying." A copywriter's try at humor leaves something to be desired. We are not seceding, but succeeding in those areas of mutual concern to the Sierra Club, as shown in its latest book, and to NATURAL HISTORY and its thousands of readers.

My own position in this area was told to a gathering of conservationists some months ago. With what some of my critics might call an exceptional show of modesty, I told the gathered conservationists I was the only governor in the history of the world to route a major highway around a bald eagle's nest. I know of no other governor who can make that statement.

At the time I was criticized for adding to the expense of the project. I summarized my own philosophy by posing a question to my critics:

How much does it cost to build a new bald eagle?

And, in a final statement of admiration for *Everglades*, let me ask readers to spare no effort to save the area as it is so beautifully depicted in what must become a landmark volume for all of us who love nature.

After all, how much would it cost to build another Everglades?

Claude R. Kirk, Jr., was governor of Florida for the past four years.

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45—top, Robert Hermes; bottom, Dade Thornton, National Audubon Soc.
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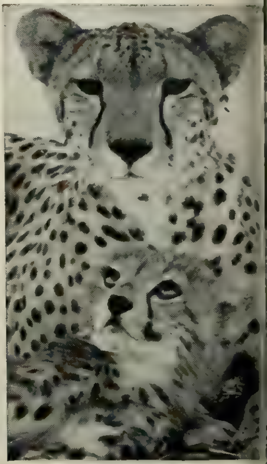

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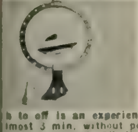

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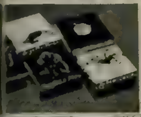

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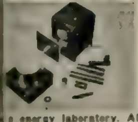

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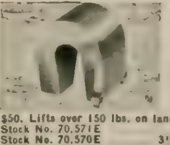

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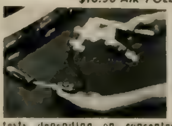

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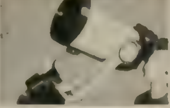

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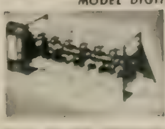

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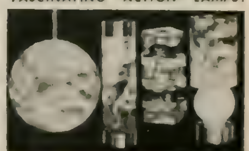

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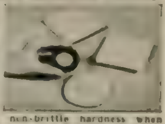

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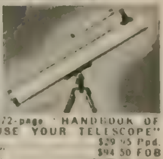

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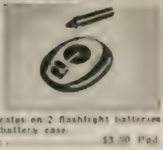

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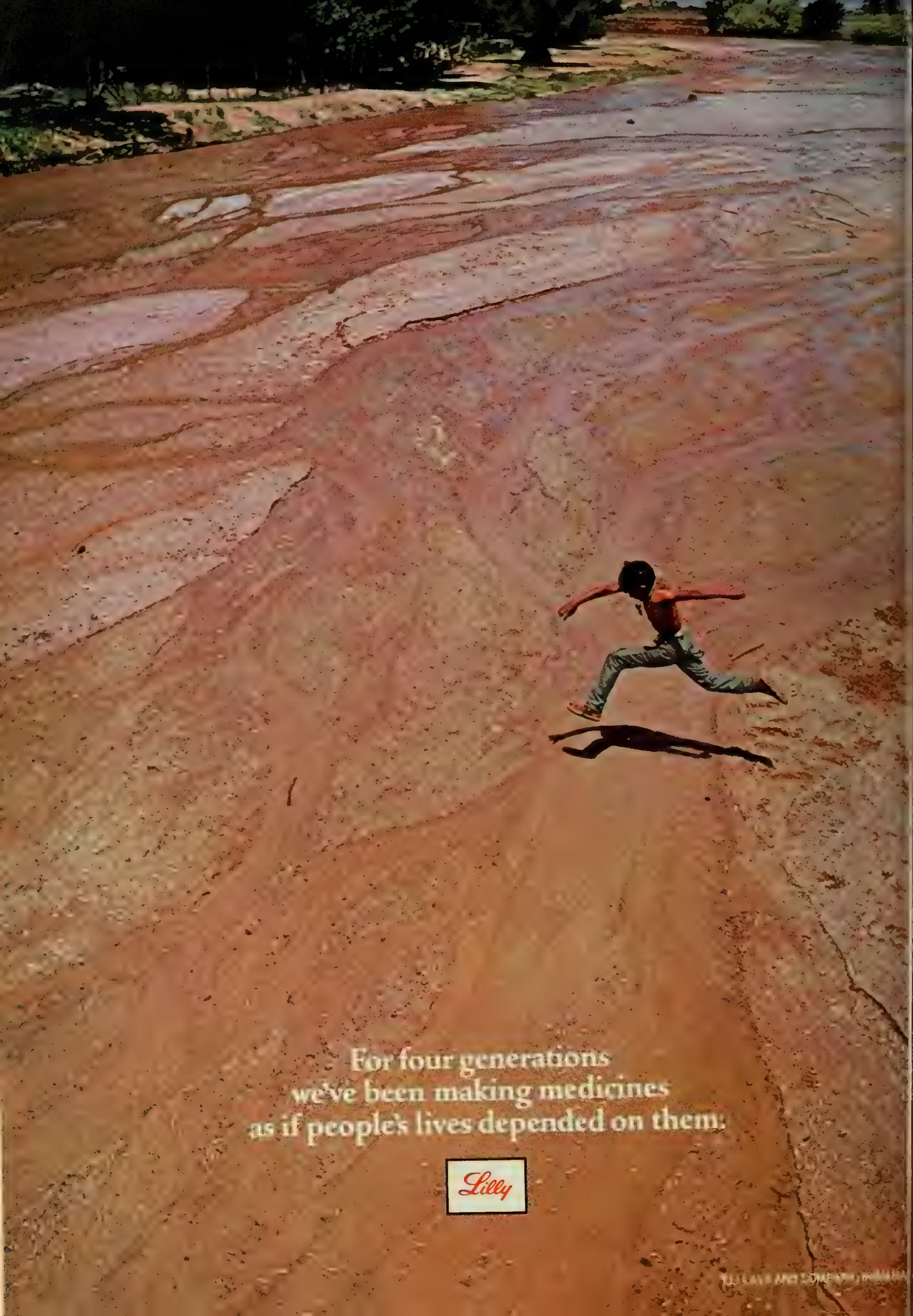
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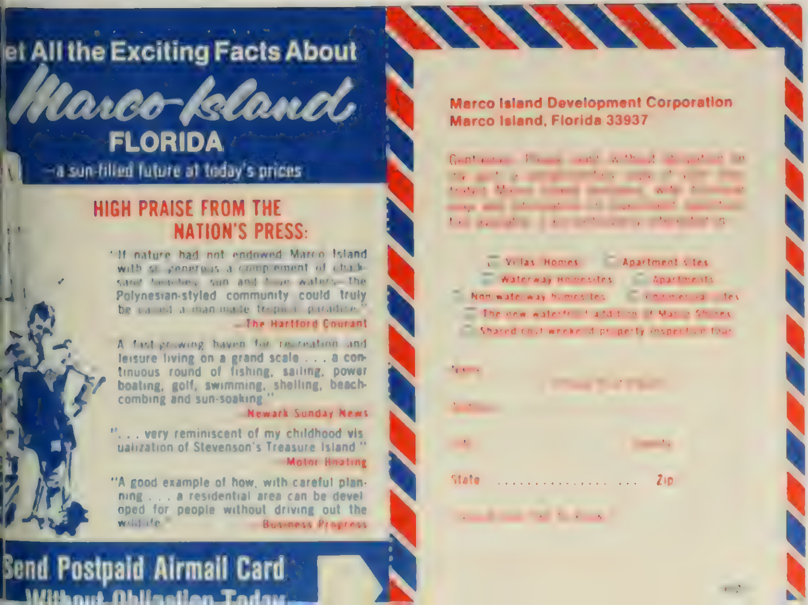

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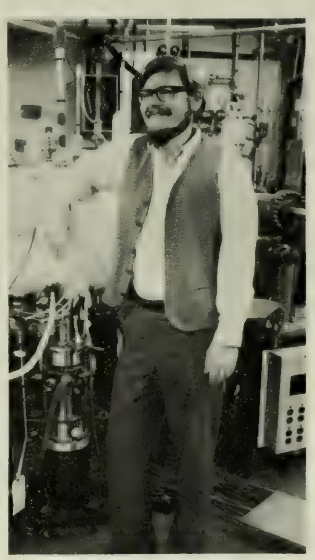
Authors

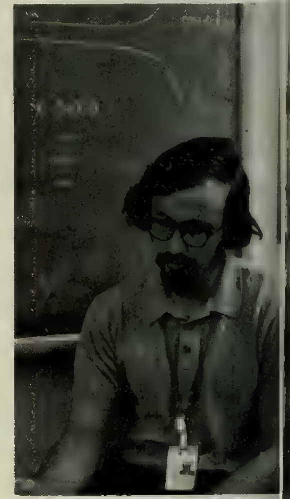
At various times in his life a cowboy, hobo, carpenter, surveyor, boatbuilder, beachcomber, newspaperman, farmer, and teacher, **Euell Gibbons** has settled into the life of a writer and lecturer. The author of such best sellers as *Stalking the Wild Asparagus* and *Stalking the Blue-eyed Scallop,* Gibbons now lives in a restored Pennsylvania Dutch farmhouse in Beavertown, Pennsylvania, with his wife, Freda. Born in Clarksville, Texas, he roamed all over the country "picking the brains of every Indian, backwoodsman and hillbilly I met," adding to his mounting lore of edible wild foods. He attended the University of Hawaii for three years where he specialized in biology, botany, and anthropology, and later took graduate courses at Temple University. Gibbons concocted his first wild food recipe at the age of five, pounding together shelled hickory nuts and sweet hackberries to make a candy bar. While he and his wife eat some wild foods nearly every day, he doesn't feel there is any special virtue in doing so. They are not food faddists, but rather collect, prepare, and eat wild foods as a "form of communion and fellowship with nature."

Charles R. Anderson, a leading expert on Thoreau, has compiled and edited about 250 selections from Thoreau's personal journals into a book, *Thoreau's World: Miniatures from His Journal,* from which "Right On, Henry David!" is excerpted. Anderson is the author of several critical and scholarly books and is currently professor of American literature at Johns Hopkins University. He is also president of the Thoreau Society of America.

Coauthor with David Book of "Sky Color," **Gregory Benford** received a B.S. in physics from the University of Oklahoma and did graduate work at the University California at La Jolla, where earned a Ph.D. in theoretical ph ics. A native of Mobile, Alabai he has written a number of scie fiction novels and is a member the American Physical Society. B ford, presently a research physi with the Lawrence Radiation La ratory of the University of Cali nia, plans future studies of th monuclear fusion and relativi electron beams.



David Book has previously laborated with Gregory Benford a series of articles focusing on ‘ science in science fiction." Borr Boston, Massachusetts, he, too, is filiated with the Lawrence ation Laboratory, where he staff physicist. Book's fields study have been plasma physics statistical mechanics, and he p further research in these areas. holds a bachelor's degree from University and a Ph.D. Princeton.



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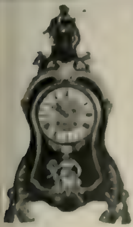
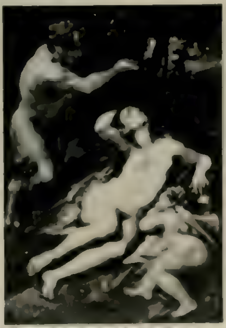
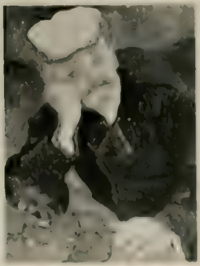


.uperbly inlaid 17th
ry clock is one of the
beautiful art objects
in full color.



Correggio's Jupiter and Antiope, Renaissance masterpiece purchased by Louis XIV in the 1660s, now at the Louvre. Full page color plate.

(Below) Van Gogh's portrait of Dr. Gachet, one of the first to recognize Van Gogh's talent. Shown in full color.



SOME OF THE FORTHCOMING VOLUMES

sures in
aly
Art Treasures in Germany
Art Treasures in Spain

Authors *continued*

Robert Sommer, author of "People's Art," is chairman of the Psychology Department of the University of California at Davis. He earned his Ph.D. at the University of Kansas in 1956. Sommer has conducted psychological studies in such locales as parks, hospitals, airports, schools, and prisons. He has also studied people's behavior in bars, the subject of a chapter in his recent book, *Personal Space: The Behavioral Basis of Design.* At the moment, he is observing and interviewing California bicyclists as part of a study on bikeways in a mixed transportation system.

Author of the special supplement, "Beyond Civilization," **Paul Bohannan** is chairman of the Department of Anthropology and Stanley Harris Professor of Social Sciences at Northwestern University. After studying German literature at the University of Arizona, he attended Oxford University, where he received the B.Sc. and D.Phil. in anthropology. The series "American Museum Sourcebooks in Anthropology" was published under the general editorship of Bohannan, and he has previously written "Place for All Things," October, 1964, and "A Man Apart," October, 1968, for NATURAL HISTORY. His current research focuses on such groups as divorcees and high school students in middle-class America.

James D. Lockie, a lecturer in wildlife management in the Department of Forestry and Natural Resources of the University of Edinburgh, has done extensive research in the ecology and land use practices of the Scottish Highlands. He is coauthor of *Ecology and Land Use in Upland Scotland* and has served as a zoologist with the Nature Conservancy in Edinburgh. Lockie received his B.Sc. degree from the University of Edinburgh and his D.Phil. from Oxford University. He
is a member of the British Trust
Ornithology and a fellow of
Royal Zoological Society of S
land.

Burney Le Boeuf is an as
ant professor of psychology at
University of California at S
Cruz. A member of the Animal
havior Society and a fellow of
New York Academy of Science
has done field work on Año Nu

and San Miguel Islands and
made numerous expeditions
other islands along the coasts
California and Baja Califor
where he tags elephant seals ev
year in all of the major rooker
He is planning a long-term study
the relation between social st
and reproductive success in m
elephant seals on Año Nuevo
land. He also plans to study the
quisition and development of
lects, and the movements
migration, of elephant seals.
Boeuf has a B.A. and Ph.D. in p
chology from the University of
ifornia at Berkeley.

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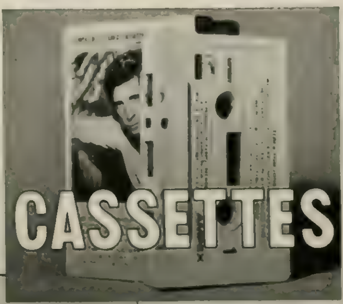

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MANTOVANI'S
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THE ASSOCIATION GREATEST HITS

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MBARDO'S
EST HITS

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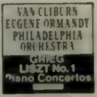
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EUGENE ORMANDY
PHILADELPHIA ORCHESTRA
GRIEG
LISZT No. 1
Piano Concertos

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JOHNNY CASH
ORIGINAL GOLDEN HITS Vol. I
Folsom Prison Blues
I Walk The Line

04024

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THE BEST OF WILSON PICKETT
I FOUND A LOVE
MUSTANG SALLY

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The SOUND of MUSIC

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ITEERS
RSON
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Jimi Hendrix
Otis Redding
Monterey Pops Festival

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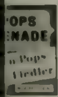
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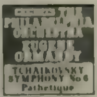
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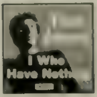
I Who Have Nothing

04105

Three Dog Night

03878

Aretha Franklin
Aretha's Gold

10523

The Best of HENRY Mancini
MOON RIVER
DAYS OF WINE AND ROSES

00222

Bert Kaempfert's Greatest Hits

00752

STEPPENWOLF
The Pusher

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THE BEST OF EDDY ARNOLD

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Gold

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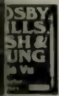
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ERIC CLAPTON

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TWIN SET
FRANK SINATRA
A MAN AND HIS MUSIC

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RAY CHARLES
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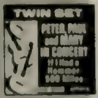
TWIN SET
PETER, PAUL and MARY IN CONCERT

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THE BEST OF AL HIRT

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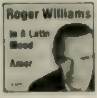
Roger Williams
In A Latin Mood
Amor

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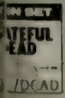
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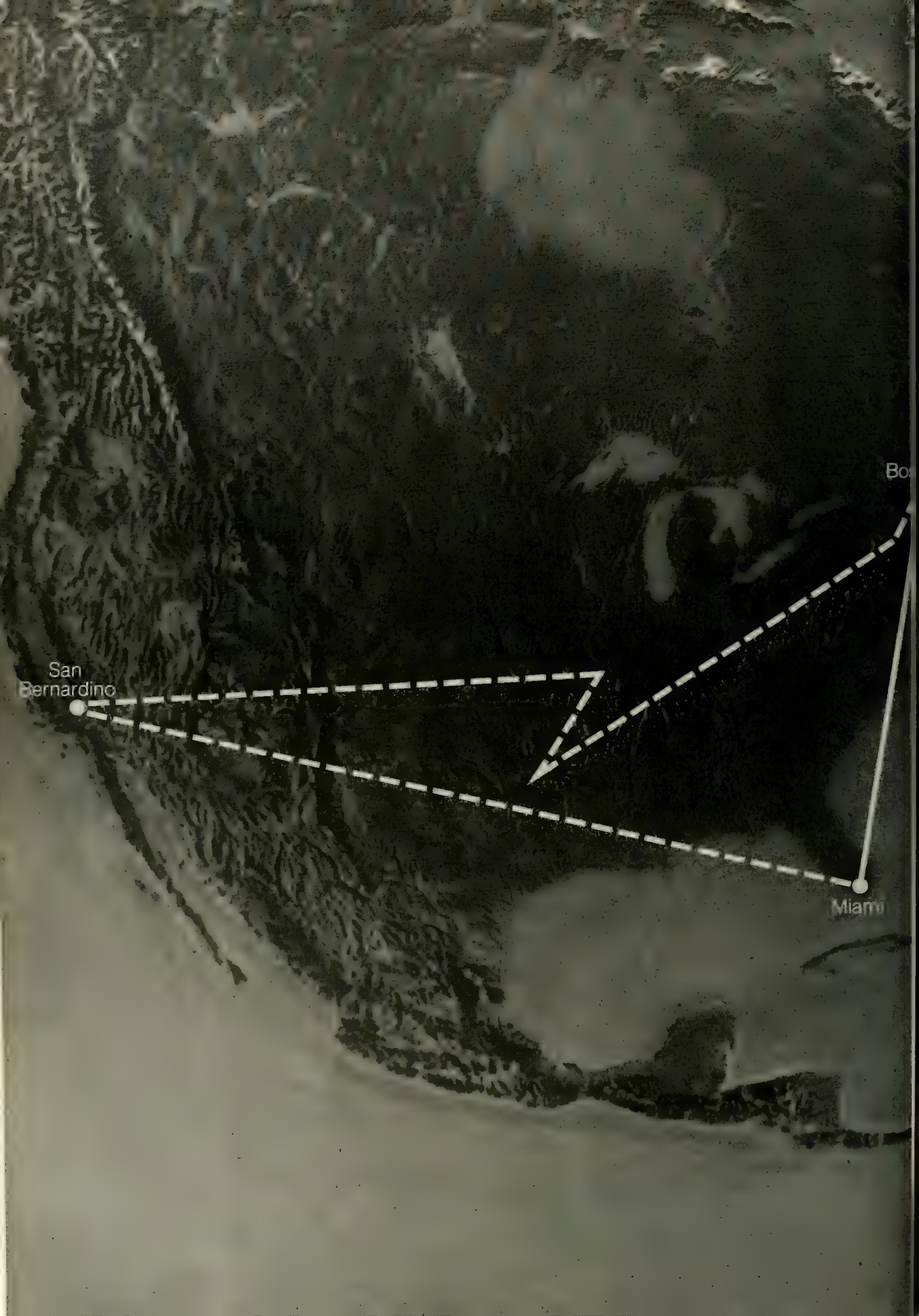
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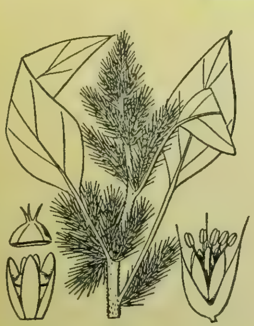
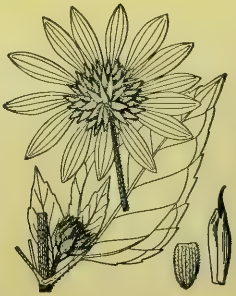
GREEN AMARANTH
(Amaranthus retroflexus)



Boil tops of young plants until tender, about 15 minutes. Drain, season with butter and salt, and add crumbled crisp bacon and chopped raw onion. (I always crumble leftover bacon and store in refrigerator for just such garnishings.) Simmer gently for about 5 minutes and serve.

A conversation-piece vegetable!

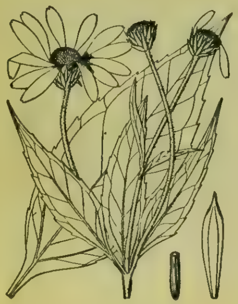
SUNFLOWER
(Helianthus annuus)



Gather unopened buds
wash, and boil until ten
er. Season with butte
and salt to serve as
vegetable. Palatable, bu
not one of the bette
ones.

Eat seeds as is or roas
in a slow oven, 275 de
grees, spread out in
shallow pan and salted
desired.

JERUSALEM ARTICHOKE
(Helianthus tuberosus)



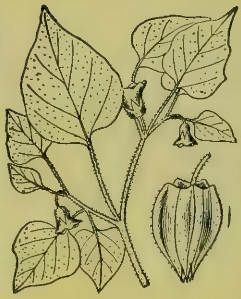
Get the men of the house to dig the tubers out of the ground in the fall and wash them off (preferably out of doors).

Peel and slice very thin and use in a mixed, tossed salad.

As a cooked vegetable, peel and cook like potatoes until tender—about 30 minutes or so. Drain, add a good chunk of butter or margarine, then salt to taste and heat for a few minutes until butter melts and coats all of the vegetable.

Although they take time to peel, they are well worth it.

GROUND CHERRY
(Physalis pubescens)

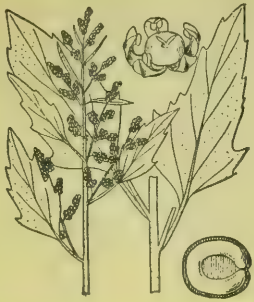


The berries can be shell
and eaten as is or used
salads. A treat either wa
But the pie is real
luscious!

¼ cup flour
1 cup sugar
¼ teaspoon salt
¼ teaspoon cinnamon
Juice of 1 lemon
9-inch unbaked pie crus

Mix first four ingredien
add lemon juice a
enough water to make
thin, smooth batter. Add
cups husked and wash
ground cherries. Mix w
and pour into pie crus
Bake about 45 minut
in 325-degree oven.
Delicious and unique!

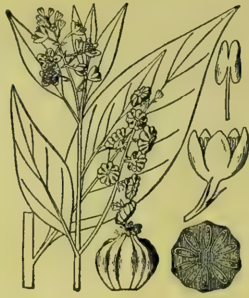
LAMB'S QUARTER
(Chenopodium album)



Gather young, tender plants less than 1 foot tall. Wash and cook in some water about 12 to 15 minutes. Drain, add butter, and season to taste.

Easy to prepare and very tasty.

POKE
(Phytolacca americana)



Gather young, tend
small sprouts, wash a
trim, leaving unrolle
clustered leaves at t
Boil in plenty of wat
for 10 minutes or so, th
drain. Add a very lit
water, butter or bac
drippings, salt to tas
and simmer slowly for
minutes, so the seaso
ing penetrates through
Ready to serve, and a
one who likes cook
greens will enjoy thes

On the Trail of the Three Sisters

;cattered about the landscape, like crumbs from a careless icnicker, grow many food plants of the original Americans

)y Euell Gibbons

recipes by Freda Gibbons

The pre-Columbian Indians of
he United States, from Canada
outhward and from the Great Ba-
in eastward, were all more or less
gricultural. Their chief crops,
orn, squash, and beans, were
alled "the three sisters." Of these,
nly beans were indigenous to the
rea; corn and squash were in-
oduced from Mexico. Corn and
ie squashes will not survive in the
ild, nor will the domesticated vari-
ies of beans, even though they
ave some close wild relatives. To
ijoy these three fine food plants,
ie Indians had to grow them.

However, their plant-food diet
as far from being limited to these
iree plants. Their approach to ag-
culture was so different from ours
iat we find their viewpoint hard to
rasp. They did not draw the clear
ne between domesticated and un-
omesticated plants that we do be-
veen crops and weeds. Even in
ieir fields and gardens they not
ily allowed but actually encour-
ged certain volunteer wild food
ants to grow, and harvested and
ed them with the same care that
iey rendered the planted crops.
aring and harvesting did not stop
the edge of the field. Natural
ild growths of food plants were
icouraged, protected, and often
tually owned by individuals or
imilies, and were marked by tying
rtain other plants to them. Other
idians generally respected these
wnership marks.

The encouragement given to wild food plants ranged from merely pulling out or chopping down competing vegetation, through pruning (especially with wild grapes), to burning off brush and forests, so that blueberries, raspberries, fireweed, and other wild food plants could take over. Being agriculturists, they understood seeds and planting and knew about transplanting. Using these methods they were able to induce many wild food plants to grow at convenient locations. Some were planted in gardens or vineyards and grown in rows. The Indians also moved wild food plants from areas where they grew naturally to new areas, either growing them as cultivated crops or introducing them as self-sustaining wild crops. Thus they were partly responsible for the distribution and composition of the flora of North America.

Two excellent food plants that the Indians moved far from their native haunts were the sunflower (*Helianthus annuus* and several other large-seeded species) and the closely related Jerusalem artichoke (*H. tuberosus*). Native to the central part of North America these were carried both east and west as cultivated crops. Unlike corn, beans, and squashes, the sunflower and the Jerusalem artichoke could sustain themselves in the wild; they escaped from cultivation and became an important part of the wild food resources of the new regions.

The sunflower sometimes succeeded better in the new locations than it had in its endemic areas because it left some of its insect enemies and other pests behind.

Nutritious and palatable, the sunflower was valuable to the Indians. The young green flower buds were boiled until tender, making a hearty vegetable with a flavor reminiscent of globe artichokes. The ripe seeds were ground into flour and used for bread and cakes. The flour was also added to soups and stews, giving them texture, nutrition, and good flavor. Sometimes the Indians simply stirred some of this flour into water and drank their lunch. Lewis and Clark tell of the Indians giving them a concoction made of sunflower meal mixed with enough marrow fat to make it the consistency of dough. I have tried this and found it a rich, high-calorie concentrated food with a pleasant flavor. It would be a great food for backpackers and others who want to travel light.

The name Jerusalem artichoke causes many misconceptions. It did not come from Jerusalem, and it is not an artichoke. Rather, it is a tuber-bearing sunflower, as its Latin name indicates. The Spaniards carried this plant from America to Europe, and the English first acquired it from them, along with the Spanish name for sunflower, *girasol*. The English corrupted this word to Jerusalem. Because of the inulin in both plants, the flavor of the cooked tubers does remind one of globe artichokes. So the plant was saddled with this ridiculous common name.

The Jerusalem artichoke submitted easily to cultivation. Apparently it is in the process of giving up the ability to bear viable seeds, propagating itself almost entirely by the tubers. Thus it is now almost wholly man's responsibility to disseminate the species in return for the food it can offer him. It is very easily raised from tubers—several times I have inadvertently started new patches of Jerusalem artichokes by throwing out the parings, stems, and rejected tubers while preparing some of the [illegible] for camp food. And once started it

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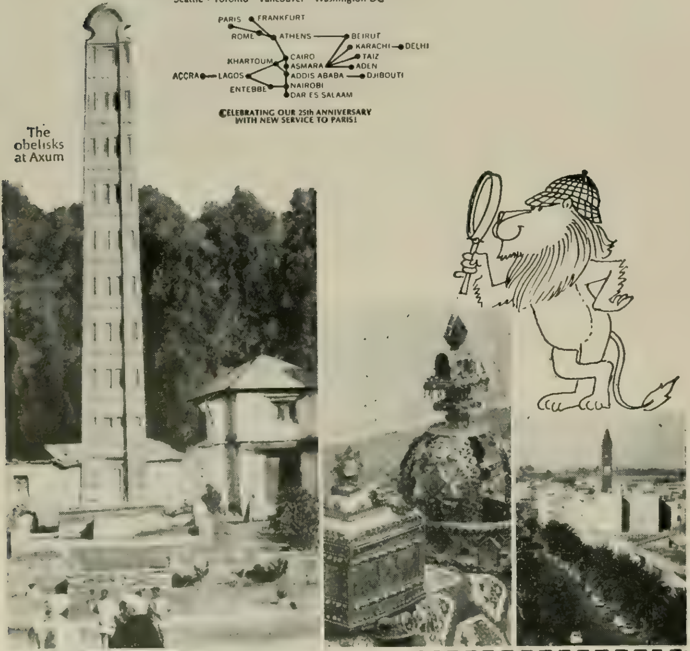

The obelisks at Axum

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is a most persistent plant; no ma ter how carefully you harvest tl tubers, enough will be overlook to assure next year's crop. A cheologists locate former Indian v lages by the patches of wild ar chokes in the neighborhood.

The Indians spread this pla from its original home across tl country and from southern Cana to Mexico. The potato-size tube are crisp, sweet, mild, and flavorf when eaten raw or mixed in sala They also make good pickles a can be cooked and eaten in alm any way that you would prepa potatoes.

Indian cultivators are probal also responsible for the pres wide range of the ground cher *Physalis* of several species. The I dians not only protected and ma use of the wild plants that came in their gardens and fields but al planted and raised the choicest sp cies and varieties. I have picked cellent ground cherries from sou ern Ontario to Mexico and fr Texas to California. Not a cher but a relative of the tomato, t ground cherry grows in lit papery husks that resemble dim utive Japanese lanterns borne tender, herbaceous plants. The cient Mesa Verde Indians ate tl fruit, for a study of ancient latrir reveals that nearly every fe sample contained *Physalis* see Apparently they ate them not o in season but year round. If left their husks, they dry nicely and w then keep indefinitely.

The berries inside the husks about one-half inch in diamet and they may be yellow, oran red, brownish yellow or browni purple when ripe, according to sp cies. All species are good to when thoroughly ripe. As a fr fruit they can be eaten as a desse with sugar and cream, or sliced i a salad as a substitute for tomato They make excellent pies and the f est jam this side of heaven. T Zuni Indians still raise them to u in a savory dish made of onio coriander, and chili.

The pokeberry, or inkbe (*Phytolacca americana*), is one the finest wild vegetables know much used by both the Indians a the early settlers. It still appears food markets. In the fall the pl sometimes stands ten feet tall, c

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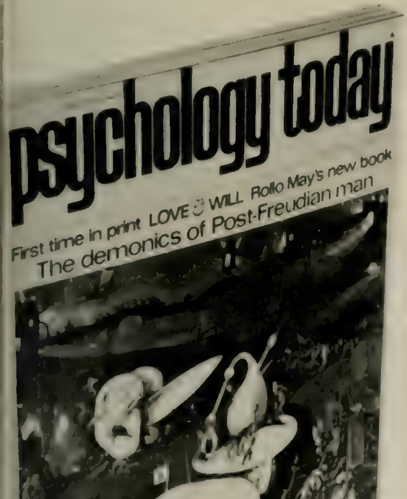
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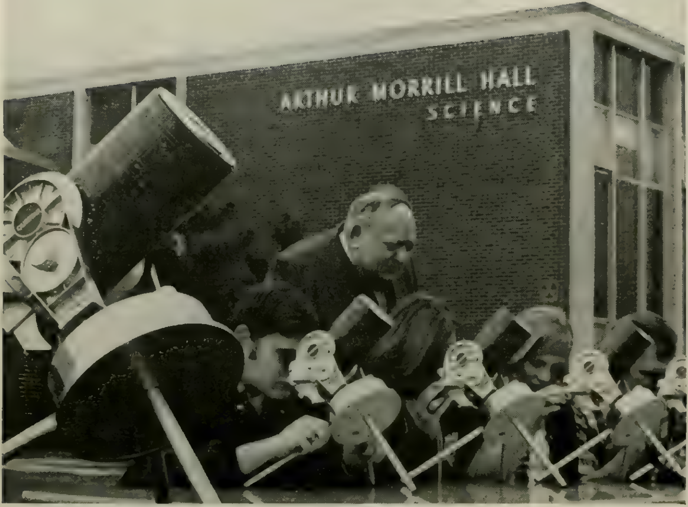

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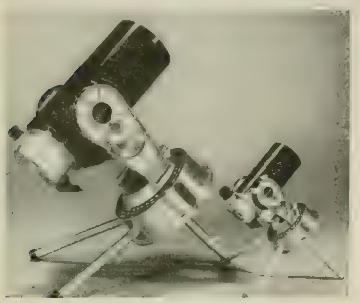

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ered with racemes of purplis
black, inedible berries. Because t
coarse stems turn a beautiful, co
spicuous lavender-purple in a
tumn, this is the time to sp
patches from which you can gath
tender sprouts the following sprir
The juice of the berries was us
for ink by early settlers. I have se
a letter written during the Ci
War with a turkey-quill pen usi
pokeberry ink, and it is still legib

The coarse stems of the pol
berry spring from a mighty ro
big as your leg. This root loc
white and succulent on the insi
but it contains phytolaccine, a dr
tic cathartic. It is not for eati
Poke can be raised from seed
those huge roots can be tra
planted so easily that the pl
seems never to know it has be
moved. The Indians no doubt us
both methods to get poke to gr
nearby. In the spring each lar
root sends up several fat spro
that resemble asparagus. Peel
boiled, and served with a but
cream sauce over toast points, t
sprouts could drive asparagus
the market. Their leafy tops c
also be cooked and are at least
good as spinach. If the sprouts a
cut back, the plant will produce se
eral crops before it must be
alone to store up energy for ne
year's sprouts.

The several species of *Am*
ranthus may have come into t
United States from the south, pos
bly introduced with corn a
squashes. A weed of cultivat
grounds, we have inelegantly chr
tened it "rough pigweed." The
dians knew long before Emers
that "a weed is a plant whose v
tues we have not yet discovere
They welcomed the plant to th
fields and sometimes even cu
vated it. The young plants can
boiled like spinach, and they ma
a fine, mild-flavored potherb. Af
each cultivation a new crop com
up, so young plants, just right
cooking, can usually be fou
throughout the warm seasons. T
old plants produce tremendo
quantities of tiny, shiny-bla
seeds. The Indians gathered t
chaffy seed heads, winnowed o
the seeds, ground them, and ma
them into cakes or bread. I ha
tried these seeds and found th
pancakes made of half amaran

eal and half wheat flour are quite
ıssable.

The several species of *Chenopo-*
)um, commonly called lamb's
ıarter or goosefoot, was another
ant relished by the Indians, and
not actually cultivated, it was
otected and encouraged. It is re-
ted to spinach and Swiss chard
ıd, in my opinion, is a better
ant than either. The young plants
n be eaten raw in salads, but I
uch prefer them well cooked. Like
maranthus, this plant produces
emendous amounts of tiny seeds,
ıll black and having much food
ılue. When ground and mixed
th wheat flour, I like them better
an *Amaranthus* seeds. The In-
ans often ground these seeds and
ade them either into cakes or
ixed them with corn meal.

Another plant that western In-
ans cultivated or encouraged to
ow near their dwellings was the
ocky Mountain bee plant, *Cleome*
rrulata. The young, tender plants
ere boiled as a potherb and were
ten immediately or rolled into
ılls and dried for food in lean
nes. Sometimes they cooked this
ant until it practically dissolved,
en pulled out the stems and con-
ıued to boil it until only a thick,
ack residue was left. This was
ied in sheets and stored as food
r the future. The seeds were also
ıthered and ground with corn to
ake a mixed seed meal.

Indians liked their salads, so they
ıltivated Spanish lettuce, *Montia*
rfoliata, a strange, easily recog-
zed plant of the West, with the
ower stems apparently growing
ght through the upper leaves. It is
ı excellent salad plant, mild in fla-
or, succulent and tender. They also
ooked and served it as we do spin-
h, and it makes a good cooked
getable.

The Indians had four chief food
urces: hunting, fishing, farming,
ıd wild food gathering. Living
oser to nature and in greater har-
ony with her than we do, they en-
yed many wild delicacies that we
ave either forgotten or neglected.
'e have made hunting and fishing
ıto sports and have long recog-
ized gardening as a pleasant recre-
ion. Now increasing numbers of
mericans are learning anew to
ather and enjoy the wild plants
ıat nature so graciously offers. ■

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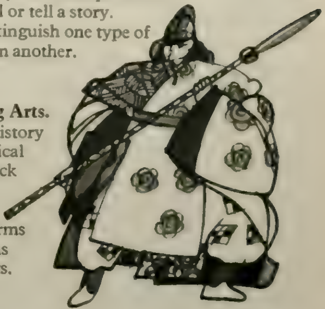

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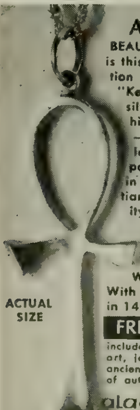

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A Naturalist at Large

Right O

Iconoclasts—young and old—continue to a the misanthrope from Walden Pond. A selection from Thoreau's obscure journa reveals why.

edited by Charles R. Ande

" 'What are you doing now?' he asked. 'Do you keep a journal So I make my first entry today."

With these words, in response to a prodding from Emerson, Henry David Thoreau embarked on a writing enterprise—his Journal*—that occupied him continuously over the entire period of his literary career, from 1837 to 1862. Beginning a few month after his graduation from Harvard and ending only a few month before his death, this extraordinary creation runs to more than seven thousand pages. In one sense, Thoreau's* Journal *is his greatest achievement as a writer, the remarkable record of a remarkable man's view of the world. Yet one would have a hard time proving it a unified whole, harder still fitting it into any traditional genre of literature. One way to explore for a definiti is to start by indicating what it is not.*

It is neither diary nor autobiography in the usual meaning these terms, because the daily chronicle and the narrative of outward events are minor aspects of this voluminous work. The entries are usually dated, it is true, but this is significant only fo a fraction of them—mostly for seasonal passages such as the blossoming of flowers, the breakup of ice on the ponds, meadow-haying, the October leaf fall. Furthermore, days at a time are skipped, occasionally weeks, without comment. The Journal *is clearly not the work of a diarist, but the notebook of a writer dedicated to the continuous practice of composition. The following excerpts are from Thoreau's* Journal:

INDIANS

The names of those who bought these fields of the red men . . . the wild men of the woods, are Buttrick, Davis, Barrett, Bulkley, etc., etc. . . . Here and there still you will find a man with Indian blood in his veins, an eccentric farmer descended from an Indian chief; or you will see a solitary pure-blooded Indian, looking as wild as ever among the pines, one of the last of the Massachusetts tribes, stepping into a railroad car with his gun.

Still here and there an Indian squaw with her dog, her only companion, lives in some lone house, insulted by school-children, making baskets and picking berries her employment. You will

enry David!

ıeet her on the highway, with few children or none, with ıelancholy face, history, destiny; stepping after her race; who ad stayed to tuck them up in their long sleep. For whom berries ondescend to grow. I have not seen one on the Musketaquid for ıany a year, and some who came up in their canoes and camped n its banks a dozen years ago had to ask me where it came from. lone Indian woman without children, accompanied by her dog, earing the shroud of her race, performing the last offices for her eparted race. Not yet absorbed into the elements again; a aughter of the soil; one of the nobility of the land. The white ıan an imported weed—burdock and mullein, which displace the round-nut.

YOUNG WOMEN AT PARTIES

In the evening went to a party. It is a bad place to go to—hirty or forty persons, mostly young women, in a small room, varm and noisy. Was introduced to two young women. The first ne was as lively and loquacious as a chickadee; had been ccustomed to the society of watering-places, and therefore could et no refreshment out of such a dry fellow as I. The other was aid to be pretty-looking, but I rarely look people in their faces, nd, moreover, I could not hear what she said, there was such a lacking—could only see the motion of her lips when I looked hat way. I could imagine better places for conversation, where here should be a certain degree of silence surrounding you, and ess than forty talking at once. Why, this afternoon, even, I did etter. There was old Mr. Joseph Hosmer and I ate our luncheon of cracker and cheese together in the woods. I heard all he said, though it was not much, to be sure, and he could hear me. And then he talked out of such a glorious repose, taking a leisurely bite at the cracker and cheese between his words; and so some of him was communicated to me, and some of me to him, I trust.

These parties, I think, are a part of the machinery of modern society, that young people may be brought together to form marriage connections.

From the book *Thoreau's World: Miniatures from His Journal*, by Charles R. Anderson. © 1971 by Charles R. Anderson. Published by Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

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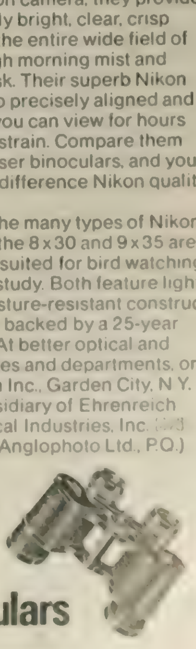

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WILD WALKS NEAR CONCORD

I can easily walk ten, fifteen, twenty, any number of miles commencing at my own door, without going by any house, without crossing a road except where the fox and the mink do. Concord is the oldest inland town in New England, perhaps i States, and the walker is peculiarly favored here. There are s miles in my vicinity which have no inhabitant. First along by t river, and then the brook, and then the meadow and the wood Such solitude! From a hundred hills I can see civilization and abodes of man afar. These farmers and their works are scarcel more obvious than woodchucks.

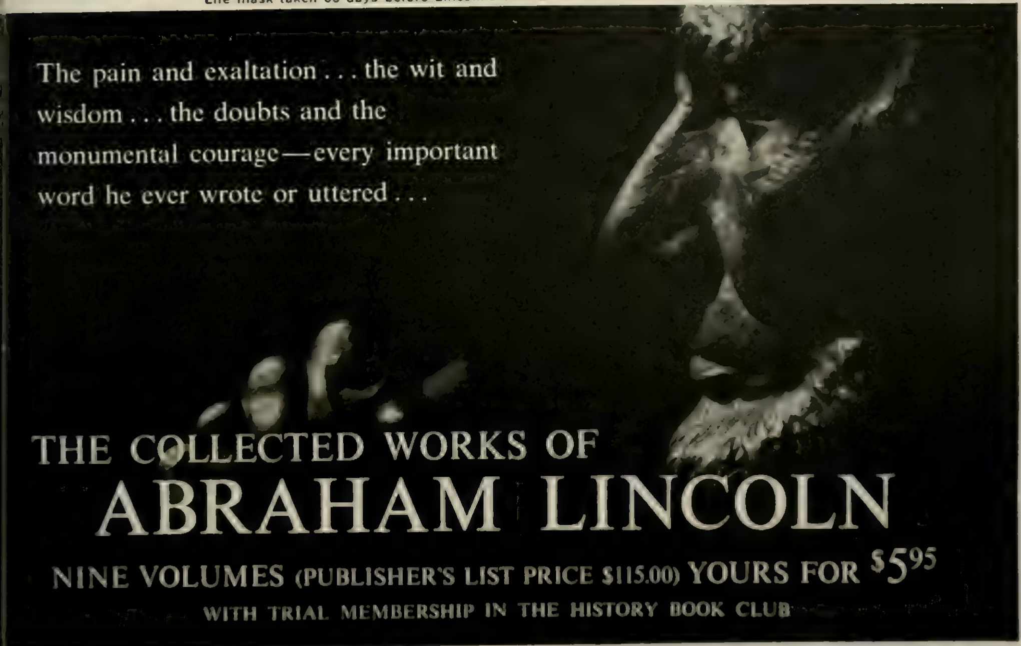
BOTANIZING

My first botany, as I remember, was Bigelow's *Plants o Boston and Vicinity*, which I began to use about twenty years ago, looking chiefly for the popular names and the short references to the localities of plants, even without any regar the plant. I also learned the names of many, but without using any system, and forgot them soon. I was not inclined to pluck flowers; preferred to leave them where they were, liked them h there. I was never in the least interested in plants in the hous But from year to year we look at Nature with new eyes. About half a dozen years ago I found myself again attending to plant with more method, looking up the name of each one and remembering it. I began to bring them home in my hat, a stra one with a scaffold lining to it, which I called my botany-box never used any other, and when some whom I visited were evidently surprised at its dilapidated look, as I deposited it their front entry table, I assured them it was not so much my h as my botany-box. I remember gazing with interest at the swa about those days and wondering if I could ever attain to suc familiarity with plants that I should know the species of every twig and leaf in them, that I should be acquainted with every plant (excepting grasses and cryptogamous ones), summer an winter, that I saw. Though I knew most of the flowers, and th were not in any particular swamp more than half a dozen shru that I did not know, yet these made it seem like a maze to me, a thousand strange species, and I even thought of commencin one end and looking it faithfully and laboriously through till I knew it all. A little thought that in a year or two I should hav attained to that knowledge without all that labor. Still I neve studied botany, and do not to-day systematically, the most na system is still so artificial. I wanted to know my neighbors, if possible—to get a little nearer to them. I soon found myself observing when plants first blossomed and leafed, and I foll it up early and late, far and near, several years in succession, running to different sides of the town and into the neighborin towns, often between twenty and thirty miles in a day. I often visited a particular plant four or five miles distant, half a do times within a fortnight, that I might know exactly when it opened, beside attending to a great many others in different directions and some of them equally distant, at the same tim the same time I had an eye for birds and whatever else migh

SHRUB OAK

A ridge of earth, with the red cockscomb lichen on it, p out still at the rut's edge. The dear wholesome color of shrub leaves, so clean and firm, not decaying, but which have put on kind of immortality, not wrinkled and thin like the white oak leaves, but full-veined and plump, as nearer earth. Well-tan leather on the one side, sun-tanned, color of colors, color of th cow and the deer, silver-downy beneath, turned toward the

Life mask taken 60 days before Lincoln's death. The hand was cast in 1860. From the collection of Clarence Hay



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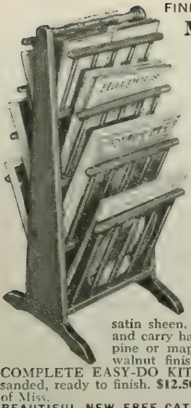

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bleached and russet fields. What are acanthus leaves and the rest, to this? Emblem of my winter condition. I love and could embrace the shrub oak with its scanty garment of leaves rising above the snow, lowly whispering to me, akin to winter thoughts, and sunsets, and to all virtue. Covert which the hare and the partridge seek, and I too seek. What cousin of mine is the shrub oak? How can any man suffer long? For a sense of want is a prayer, and all prayers are answered. Rigid as iron, clean as the atmosphere, hardy as virtue, innocent and sweet as a maiden is the shrub oak. In proportion as I know and love it, I am natural and sound as a partridge. I felt a positive yearning toward one bush this afternoon. There was a match found for me at last. I fell in love with a shrub oak. Tenacious of its leaves, which shrivel not but retain a certain wintry life in them, firm shields, painted in fast colors a rich brown. The deer mouse, too, knows the shrub oak and has its hole in the snow by the shrub oak's stem.

WILD FRUITS

I have carried an apple in my pocket to-night—a sopsivine they call it till, now that I take my handkerchief out, it has got so fine a fragrance that it really seems like a friendly trick of some pleasant demon to entertain me with. It is redolent of sweet-scented orchards, of innocent, teeming harvests. I realize the existence of a goddess Pomona, and that the gods have really intended that men should feed divinely, like themselves, on their own nectar and ambrosia. They have so painted this fruit, and freighted it with such a fragrance, that it satisfies much more th an animal appetite. Grapes, peaches, berries, nuts, etc., are likewise provided for those who will sit at their sideboard. I have felt, when partaking of this inspiring diet, that my appetite was an indifferent consideration; that eating became a sacrament, a method of communion, and ecstatic exercise, a mingling of bloods, and [a] sitting at the communion table of the world; and so have not only quenched my thirst at the spring but the health of the universe.

The indecent haste and grossness with which our food is swallowed have cast a disgrace on the very act of eating itself. But I do believe that, if this process were rightly conducted, its aspects and effects would be wholly changed, and we should receive our daily life and health, Antaeus-like, with an ecstatic delight, and, with upright front, an innocent and graceful behavior, take our strength from day to day. This fragrance of the apple in my pocket has, I confess, deterred me from eating of it. I am more effectually fed by it another way.

It is, indeed, the common notion that this fragrance is the only food of the gods, and inasmuch as we are partially divine w are compelled to respect it.

CHANTICLEER

Let a full-grown but young cock stand near you. How full of life he is, from the tip of his bill through his trembling wattles and comb and his bright eye to the extremity of his clean toes! How alert and restless, listening to every sound and watching every motion! How various his notes, from the finest and shrill alarum as a hawk sails over, surpassing the most accomplished violinist on the short strings, to a hoarse and terrene voice or cluck! He has a word for every occasion; for the dog that rushe past and partlet cackling in the barn. And then how, elevating himself and flapping his wings, he gathers impetus and air and launches forth that world-renowned ear-piercing strain! not a vulgar note of defiance, but the mere effervescence of life, like the bursting of a bubble in a wine-cup. Is any gem so bright as his eye?

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WOOD THRUSH

The wood thrush's [song] is no opera music; it is not so much the composition as the strain, the tone—cool bars of melod from the atmosphere of everlasting morning or evening. It is the quality of the song, not the sequence. In the peawai's note there is some sultriness, but in the thrush's, though heard at noon, there is the liquid coolness of things that are just drawn from the bottom of springs. The thrush alone declares the immortal wealth and vigor that is in the forest. Here is a bird in whose strain the story is told, though Nature waited for the science of aesthetics to discover it to man. Whenever a man hears it, he is young, and Nature is in her spring. Wherever he hears it, it is a new world and a free country, and the gates of heaven are not shut against him. Most other birds sing from the level of my ordinary cheerfu hours—a carol; but this bird never fails to speak to me out of a ether purer than that I breathe, of immortal beauty and vigor. He deepens the significance of all things seen in the light of his strain. He sings to make men take higher and truer views of things. He sings to amend their institutions; to relieve the slave on the plantation and the prisoner in his dungeon, the slave in the house of luxury and the prisoner of his own low thoughts.

HAWK AS SYMBOL

The hen-hawk and the pine are friends. The same thing which keeps the hen-hawk in the woods, away from the cities, keeps me here. That bird settles with confidence on a white pine top and not upon your weathercock. That bird will not be poultry of yours, lays no eggs for you, forever hides its nest. Though willed, or *wild*, it is not willful in its wildness. The unsympathizing man regards the wildness of some animals, their strangeness to him, as a sin; as if all their virtue consisted in their tamableness. He has always a charge in his gun ready for their extermination. What we call wildness is a civilization other than our own. The hen-hawk shuns the farmer, but it seeks the friendly shelter and support of the pine. It will not consent to walk in the barn-yard, but it loves to soar above the clouds. It has its own way and is beautiful, when we would fain subject it to ou will. So any surpassing work of art is strange and wild to the mas of men, as is genius itself. No hawk that soars and steals our poultry is wilder than genius, and none is more persecuted or above persecution. It can never be poet laureate, to say "Pretty Poll" and "Polly want a cracker."

BRUTE NEIGHBORS

I spend a considerable portion of my time observing the habits of the wild animals, my brute neighbors. By their various movements and migrations they fetch the year about to me. Very significant are the flight of geese and the migration of suckers, etc., etc. But when I consider that the nobler animals have been exterminated here—the cougar, panther, lynx, wolverene, wolf, bear, moose, deer, the beaver, the turkey, etc., etc.—I cannot bu feel as if I lived in a tamed, and, as it were, emasculated country. Would not the motions of those larger and wilder animals have been more significant still? Is it not a maimed and imperfect nature that I am conversant with? As if I were to study a tribe of Indians that had lost all its warriors. Do not the forest and the meadow now lack expression, now that I never see nor think of the moose with a lesser forest on his head in the one, nor of the beaver in the other? When I think what were the various sounds and notes, the migrations and works, and changes of fur and plumage which ushered in the spring and marked the other seasons of the year, I am reminded that this my life in nature, particular round of natural phenomena which I call a year, is

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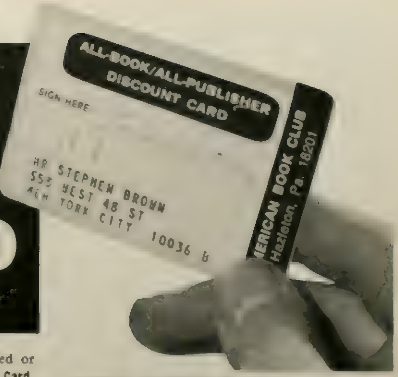

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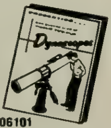

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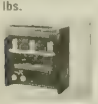

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lamentably incomplete. I listen to [a] concert in which so many parts are wanting. The whole civilized country is to some extent turned into a city, and I am that citizen whom I pity. Many of those animal migrations and other phenomena by which the Indians marked the season are no longer to be observed. I seek acquaintance with Nature—to know her moods and manners. Primitive Nature is the most interesting to me. I take infinite pains to know all the phenomena of the spring, for instance, thinking that I have here the entire poem, and then, to my chagrin, I hear that it is but an imperfect copy that I possess and have read, that my ancestors have torn out many of the first leaves and grandest passages, and mutilated it in many places. I should not like to think that some demigod had come before me and picked out some of the best of the stars. I wish to know an entire heaven and an entire earth. All the great trees and beasts, fishes and fowl are gone.

THE PROPER STUDY OF MANKIND

It appears to me that, to one standing on the heights of philosophy, mankind and the works of man have sunk out of sight altogether; that man is altogether too much insisted on. The poet says the proper study of mankind is man. I say, study to forget all that; take wider views of the universe. That is the egotism of the race. What is this our childish, gossiping, social literature, mainly in the hands of the publishers? When another poet says the world is too much with us, he means, of course, that man is too much with us. In the promulgated views of man, in institutions, in the common sense, there is narrowness and delusion. It is our weakness that so exaggerates the virtues of philanthropy and charity and makes it the highest human attribute. The world will sooner or later tire of philanthropy and all religions based on it mainly. They cannot long sustain my spirit. In order to avoid delusions, I would fain let man go by and behold a universe in which man is but as a grain of sand. I am sure that those of my thoughts which consist, or are contemporaneous, with social personal connections, however humane, are not the wisest and widest, most universal. What is the village, city, State, nation, aye the civilized world, that it should concern a man so much? the thought of them affects me in my wisest hours as when I pass a woodchuck's hole. It is a comfortable place to nestle, no doubt, and we have friends, some sympathizing ones, it may be, and a hearth there; but I have only to get up at midnight, aye to soar or wander a little in my thought by day, to find them all slumbering. Look at our literature. What a poor, puny, social thing, seeking sympathy! The author troubles himself about his readers—would fain have one before he dies. He stands too near his printer; he corrects the proofs. Not satisfied with defiling one another in this world, we would all go to heaven together. To be a good man, that is, a good neighbor in the widest sense, is but little more than to be a good citizen. Mankind is a gigantic institution; it is a community to which most men belong. It is a test I would apply to my companion—can he forget man? can he see this world slumbering?

I do not value any view of the universe into which man and the institutions of man enter very largely and absorb much of the attention. Man is but the place where I stand, and the prospect hence is infinite. It is not a chamber of mirrors which reflect me. When I reflect, I find that there is other than me. Man is a past phenomenon to philosophy. The universe is larger than enough for man's abode. Some rarely go outdoors, most are always at home at night, very few indeed have stayed out all night once in their lives, fewer still have gone behind the world of humanity, seen its institutions like toadstools by the wayside.

Glen Conway just gave birth to an eight-year-old.

; true. And the whole Conway family is delighted. en knows about helping because his dad is a police- in and helps people all the time. So when Glen ard about Save the Children Federation in school, wanted to do something. His parents decided it uld, indeed, be wonderful to sponsor a child. To e their eleven-year-old a chance to learn how chil- en in other countries, children less fortunate than ir son, must fight for survival. And that's how tonio Laverde came into their lives.

Glen and Antonio are separated by a lot more than e miles between Long Island and Colombia. Antonio es in one room. With eight brothers and sisters. up made with potatoes and roots is his main meal. u see, his dad only has the use of one arm. And en though he works long hours at odd jobs, he still rns just five dollars a week.

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Sky Color

by
Gregory Benford
and
David Book

Physical effects in the earth's transparent atmosphere produce some spectacular colors. Then there's the sky on Tau Ceti I....

Imagine yourself transported twelve light-years to one of the nearest stars that resembles our own, Tau Ceti. Suppose a planet circles this star, and in the nomenclature of the astronomers, call it Tau Ceti I. Further, suppose this planet is inhabited. A boy and his father are standing tentacle in tentacle in their yard.

"Daddy, why is the sunset so green?" the boy asks. His father's eyes brighten with pride at this mark of his son's intellectual curiosity. Then pride gives way to sudden apprehension. He doesn't know why.

Earthly fathers have known moments of similar distress, because the range of atmospheric phenomena is mystifyingly great, even on earth.

The first fact about air, the one almost everyone knows, is that it is a colorless, odorless gas. But if this is so, why do we on earth have blue skies, white clouds, red and orange sunsets and multicolored rainbows? If you had never seen a planet with an atmosphere before and someone described the mundane facts of the earth's atmosphere to you, would you have predicted all these effects? After all, what is our air? Six million billion tons of nitrogen, oxygen, argon, and water vapor plus a few traces of other gases and a little dust. It is bound to earth by gravity and extends out a few hundred miles, becoming increasingly rarefied until it is indistinguishable from the sparse gases of space. If the whole ocean of air could somehow be packed down to maintain all of it at sea-level pressure and room temperature, it would be about five miles deep. The trace gases in it would take up only about ten feet. But, as in French cuisine, it is the small touches that make the difference.

With the exception of ozone, which is faintly bluish, all these gases are invisible. The colors we see in our sky—or might see in Tau Ceti I's sky, were we to go there—stem from a number of different physical effects taking place within the gases of the air. And the color we see depends on our eyes: Tau Cetan eyes might not be adapted for viewing terrestrial skies or human eyes for viewing theirs. The human eye is, after all, a very specialized organ. It is a light detector responding to colors between red and violet. Eye sensitivity is greatest around green, dropping off to zero toward the violet and red extremes. A few people can see well down into the ultraviolet, but they don't see a new color. [illegible]

That blue sky we are so used to on earth may be green on another planet—or yellow or deep red or even white.

that such light simply looks very purple.

Before trying to explain the colors of Tau Ceti I's air, we really should study the earth's. Meteorologists know quite a few exotic effects that occur nearly everywhere on our globe, which few people ever notice. Sometimes these phenomena are fleeting or take place when people are indoors. Sometimes they are obscured in cities by pollution.

Ordinary daylight is a mixture of the colors of the visible spectrum, sometimes called white light. An object seen outdoors looks, say, yellow if the light coming from it has relatively more intensity in the yellow than in the other colors, compared with white light. This can happen if it emits yellow light or if daylight is reflected from it in such a way that the yellow components are reflected more effectively than are the red, orange, green, or other colors.

If an object seen by transmitted light—for example, a smog layer or a piece of stained glass—looks yellow, this is because the other wavelengths are preferentially absorbed in passing through it. Yellow light gets through more efficiently than others, and so the transmitted light looks yellow by comparison with white light. There is nothing special about yellow, of course; similar remarks apply to the other colors.

Our sun provides the light by which we see all the common atmospheric optical effects. The sun emits energy at an almost constant rate, most of it in the visible spectrum. If the energy per unit wavelength is plotted on a graph, the resultant curve looks like that for a "black body" at 10,000° F., with some irregularities. A black body is an ideal object, a theoretical entity that absorbs all radiation falling upon it and is the best possible emitter. But most real, solid objects radiate energy over a spectrum of wavelengths more or less like that of a black body.

Not all of this radiation penetrates the atmosphere. Practically nothing gets through with a wavelength of less than 3,000 Angstroms (1 Angstrom = 4 billionths of an inch), while much of the infrared portion is blocked as well. Because the longer-wave radiation is less energetic ("softer"), almost all of the solar energy that penetrates our blanket of air to where we live is in the visible spectrum. That this part of the spectrum is visible to us is no accident—evolution has adapted our eyes to make use of available sunlight. Enough gets through per square yard every ten minutes to vaporize a pint of water.

The radiation that fails to penetrate is absorbed by gases in our air. Most infrared absorption is caused by water vapor and carbon dioxide. At the other end of the spectrum, oxygen and ozone screen out almost all the ultraviolet light. Ultraviolet causes sunburn, but most of it never gets to us. Ozone is the vital factor, although it occurs at the rate of less than one molecule in two million in the air, concentrated at an altitude about fifteen miles above the earth's surface. If it weren't for that ozone filter, we would be sunburned to death within a few hours. The rest of our air (including nitrogen, which is four-fifths of the total volume) absorbs no sunlight on its way to us.

A gas like chlorine, often suggested by science-fiction writers as an alternative life-supporting agent in unearthly atmospheres, is another matter. Chlorine is greenish yellow because it absorbs light preferentially in the blue and red-orange wavelengths. But there is also substantial absorption in the green. A chlorine atmosphere more than a few yards thick would transmit *no* visible light. If the hypothetical inhabitants of Tau Ceti I should happen to be chlorine breathers, they must have evolved in what we would regard as total darkness. What radiation they actually see by—for surely their eyes would not resemble ours—would depend on the other ingredients in their air and the radiation emitted by Tau Ceti.

What color is Tau Ceti I's sky? Well, take the earth: why is our sky blue? The answer does not lie in the air's absorption properties, but in a process called scattering. As two Englishmen, Tyndall and Ra
leigh, discovered a century ago,
light wave passing through a tra
parent medium containing partic
smaller than the wavelength of t
light suffers occasional small defl
tions. These deflections are rando
if the particles are randomly
cated—as they are in an atm
sphere—and the probability of d
flection grows as the distan
traveled increases. Further, t
shorter wavelengths (bluer color
are scattered more strongly.

It is simple to apply this to su
light. As the sun's rays pa
through the air they are scatter
by air molecules; a little of the r
light, more of the yellow and gree
and a lot of the blue and violet a
scattered. The scattered light a
pears to come, not from the su
but from the air all about, that i
from the sky. Since our eyes a
more sensitive to blue than to vi
let, the sky looks blue. And becau
blue light is scattered out of the d
rect solar rays when we lo
straight at the sun, the sun seen
redder than it would in outer spac

This "Rayleigh scattering" o
curs only when the scatterers a
small compared with a wavelengt
Visible light has wavelengths a hu
dred times shorter than the thic
ness of the paper these words a
printed on, but molecules in the a
are a thousand times smaller tha
that.

As the scatterers increase in siz
the dependence on wavelength d
minishes. For particles as large as
wavelength or larger—such as w
ter vapor droplets—all wavelengt
are deflected equally. White lig
scattered by such particles st
looks white. That is why ordina
clouds and fog (where the wat
droplets are bigger than t
wavelengths of light) look gray
milky. They will look that way o
Tau Ceti I, too.

On a clear day, one cannot s
forever, but only about 170 mile
That is the distance light in t
middle of the visible spectrum c
travel through perfectly clean, d
air, before absorption and scatte
ing weaken it substantially. Act
ally, because of the earth's cu
vature, there is no place where o

In this telescopic view of Venus setting, the components of its light are separated by refraction in our atmosphere.

n find a line of sight 170 miles ng lying in the lower atmosphere. it even if there were, it would not "clear."

Even over deserts there is a thin ater haze that cuts down on visility. There is also a certain nount of dust present everywhere. cally, this may arise from wind rms over deserts, salt sprayed by ean waves, or pollution. Over the hole surface of the earth, though, ost dust is produced by meteites, farming, and volcanic erupns. This dust component is reonsible for the scattering and sorption effects that are comparle to those caused by molecules the air.

Above each square mile of the rth's surface there is, on the avage, about one thousand pounds dust. This figure is frequently varfed by the quantities of pollunts spewed into the air above ties and factories, which are metimes measured in tons per uare mile. Although smog and smoke particles can cause dramatic changes in local climate, their effect on the total global climate is still unknown. (We should keep in mind that if Tau Ceti I is inhabited by a runaway technological society as short-sighted as ours seems to be, its air might have become a rich ruddy brown.)

The most dramatic visual effect of atmospheric dust is in coloring sunsets. Small dust particles scatter light according to Gustav Mie's theory. When the sun is close to the horizon, its rays travel perhaps ten or twenty miles through the dense lower layers of the air. Instead of the slight scattering that occurs when it is overhead, there is almost complete diversion of the blue wavelengths. The other colors are attenuated, too, although not so strongly, so that the sun appears relatively dim and very red. Clouds near the horizon are painted pink and crimson, or the sky near the sun may be yellow on account of the same Rayleigh scattering, now operating to separate the shorter wavelength yellow light from red.

What is it like on Tau Ceti I? The answer for any planet begins with the nature of the local sunlight. Hot stars radiate mainly blue or ultraviolet light; cold ones put out red or infrared. As long as we are using our imaginations, we might choose a planet that circles not one, but two stars. (This is possible if the stars are close enough.) If one were red and the other blue, the sky would provide a light show of surpassing beauty as the two stars alternately set or eclipsed each other. But let us stick to Tau Ceti, which is a near twin to our sun, so that any important differences come from the planet's air.

A world with free oxygen in its atmosphere will be shielded from ultraviolet light, because protective ozone will be formed as the oxygen absorbs high-energy radiation from the star. If water vapor or carbon dioxide is present, most infrared will be screened out as well, and the sunlight will resemble that on earth. But if a great deal more ozone is present, it will absorb most of the blue and yellow sunlight, and only an infernal red will reach the earth's surface.

Aside from the hydrocarbons and some hydrogen-carbon-chlorine compounds, only a few substances are gaseous at temperatures such as those we are used to. Some of them, like the inert gases and nitrogen, are very weak absorbers. Most of the others absorb only at infrared wavelengths. For the remainder, the absorption at visible wavelengths is so weak that no one has ever measured it accurately. We know, for example, that ammonia and methane tend to absorb red light and pass blue and yellow. Uranus and Neptune, which both have considerable quantities of methane in their atmospheres, tend to look blue-green through a telescope.) But it is hard to be more precise than that. If Tau Ceti I is a methane planet, the sun might appear green while the sky would still be blue.

A planet having the same sort of atmosphere as our own, but orbiting a cool red star, would get comparatively little blue light. From the surface, the sun would seem cherry or wine-red even at midday, while Rayleigh scattering would make the sky green or even yellow!

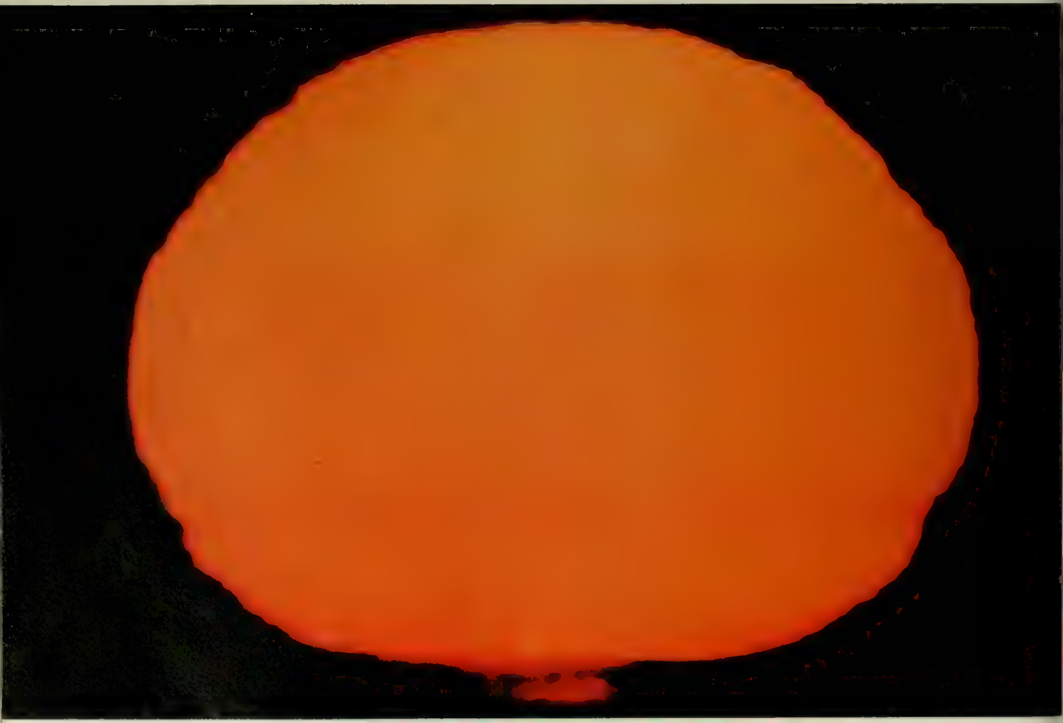
Speculation about color effects in completely hypothetical atmospheres is rather pointless, though. For one thing, it leaves out the important effects of atmospheric dust and aerosols. These make for spectacular effects on our own planet.

For instance, after every major volcanic eruption, unusual lighting in the sky and especially beautiful sunsets occur for several months or years. After the great eruption of 1783 in Iceland, the sun and moon appeared "as red as the juice of cherries." Caused by the joint action of haze and dust, similar spectacles all over the world followed the eruptions of Babuyan (1831), Krakatoa (1883), Pelée (1902), and Katmai (1912). Scattering by volcanic dust also causes the "Bishop's ring," a reddish ring around the sun that subtends an angle of about 30 degrees.

On September 23, 1950, great forest fires raged through Alberta. Oil droplets arose from distillation of the wood in the heat of the fire. On the following days, the sun appeared in Ontario, and then in Europe, to have a deep indigo color. Smoke particles and oil droplets scattered red and yellow light preferentially, reversing the effect of the usual Rayleigh scattering. A "blue moon" can occur because of dust or smoke at high altitudes. This phenomenon is reported with fair frequency in Jamaica. The sunsets along the California coast during the 1970 brush and forest fires were a particularly ruddy red.

Similar materials make up m
of the contents of urban sm
cover, although "smog" may den
several different conditions. Sm
droplets and particles have a w
range of sizes, so they scatter
ferent colors preferentially.
characteristic brown color of
true connoisseur's Los Angeles-t
smog layer is not caused by scatt
ing but by absorption, most of
resulting from the presence of
dish-brown nitrogen dioxide. (T
is one atmospheric gas that is
colorless, odorless, and tasteless.
has been estimated that in Calif
nia these days, man produces
much of it as nature does.)

As the setting sun ne
the horizon, a "red flas
occurs at the bottom
the disk, signaling t
start of refraction effec



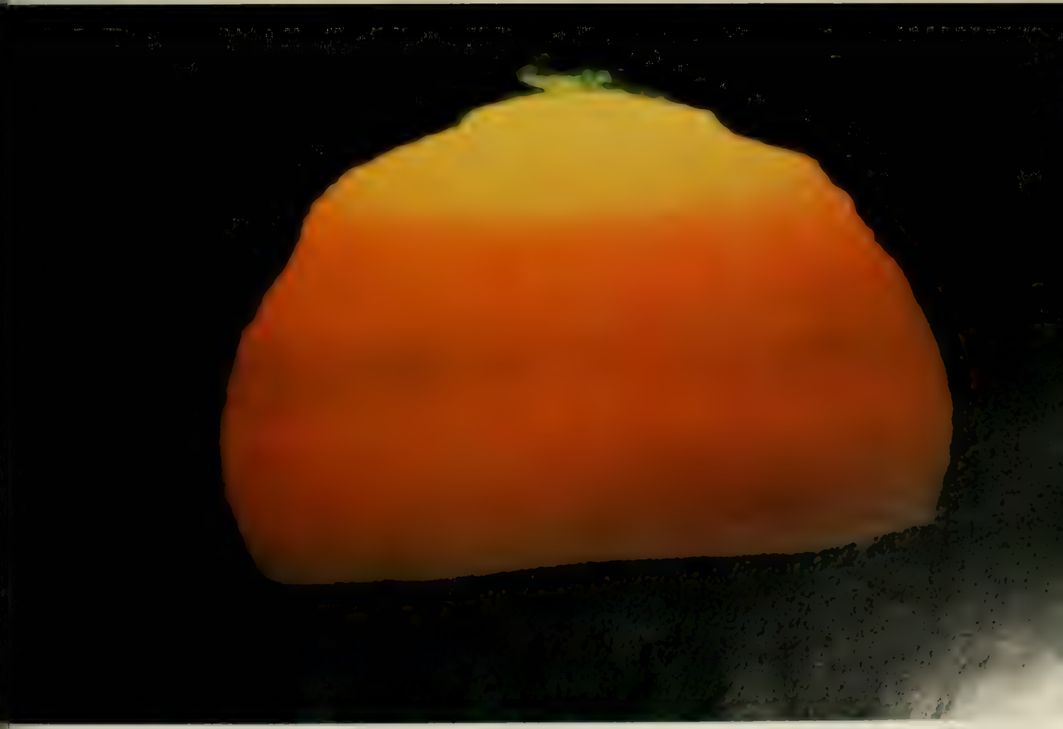
Dust and liquid drops suspended
the air are also important in con-
ction with the earth's heat bal-
ce. Of all the solar radiation
iking the earth's atmosphere, 30
rcent is reflected and the rest ab-
rbed. The absorbed fraction, plus
at from the radioactive minerals
the interior and from cooling of
e core, acts to maintain the sur-
e at the temperatures we like.
e earth radiates energy away so
to just balance the input. We
nnot see most of it, because the
diation is in the infrared part of
e spectrum.

If the atmosphere were missing,
s infrared radiation would go blasting out into space and the earth would cool to arctic temperatures. But because water vapor and carbon dioxide are such good infrared absorbers, the air acts like an insulating blanket. This is sometimes known as the greenhouse effect, and it will operate as well on our hypothetical Tau Ceti I as it does here.

(Actually, the interior of a greenhouse stays warm for a different reason. Sunlight passes through the glass walls and roof and heats the air inside, which tends to rise. Because the glass is solid, the hot air cannot go anywhere and so the heat stays inside. While it is true that glass is fairly opaque to infrared radiation, this has nothing to do with the matter. A greenhouse of rock salt panes—which are transparent to infrared—was built in 1909 just to test this point, and it worked perfectly well.)

There is so much water in the oceans, which average two miles in depth, that nothing man does can greatly change the amount of water vapor. On the other hand, the oceans contain only an estimated sixty times as much carbon dioxide as does the air, and man can affect that. The ocean acts as a reserve or buffer: if the amount of atmospheric carbon dioxide decreases, it is replaced with an equal amount from the oceans, while if it increases, the excess eventually dissolves back into them. Given enough time, that carbon dioxide might be transformed instead into forests or coal deposits, but this takes millions of years. Even the oceanic buffering effect is pretty slow. But human technology in the last century has taken to burning coal, oil, and wood at such a tremendous rate that the amount of carbon dioxide in the air has increased by a few percent. This makes the atmosphere a more efficient insulator, which would lead one to expect climates to gradually become warmer.

But that is not the whole story. Technological "progress" has also



ter the "green flash"
pears at the top of the sun.
ese unique photographs from
e Vatican Observatory are
mous among meteorologists.

led to atmospheric pollution, increasing the amount of smoke, smog, and dust in the air, some of it in layers far from the ground. Pollutant particles are typically about the same size as water vapor droplets in fog: that is, large enough to reflect more incoming solar radiation back out into space so that it never reaches the surface, but small enough so that outgoing infrared rays are only scattered and eventually leave the atmosphere as well. This means heat would be lost, and we could expect temperatures to drop.

So far, the net change is unclear. Many people, however, are understandably reluctant to prolong the experiment until a definite result appears.

We already know one planet that seems to have both a greenhouse effect and a natural smog bank: Venus. It is almost the same size as the earth and has a surface temperature of 800 degrees, with an atmospheric pressure perhaps a hundred times greater than ours. Its air is composed almost entirely—at least 95 percent—of carbon dioxide, with, at most, traces of water and oxygen. Thick yellowish-white clouds sit at the top of Venus's atmosphere. Their composition and extent are unknown, although there are indications that they contain droplets or particles about the size of smog.

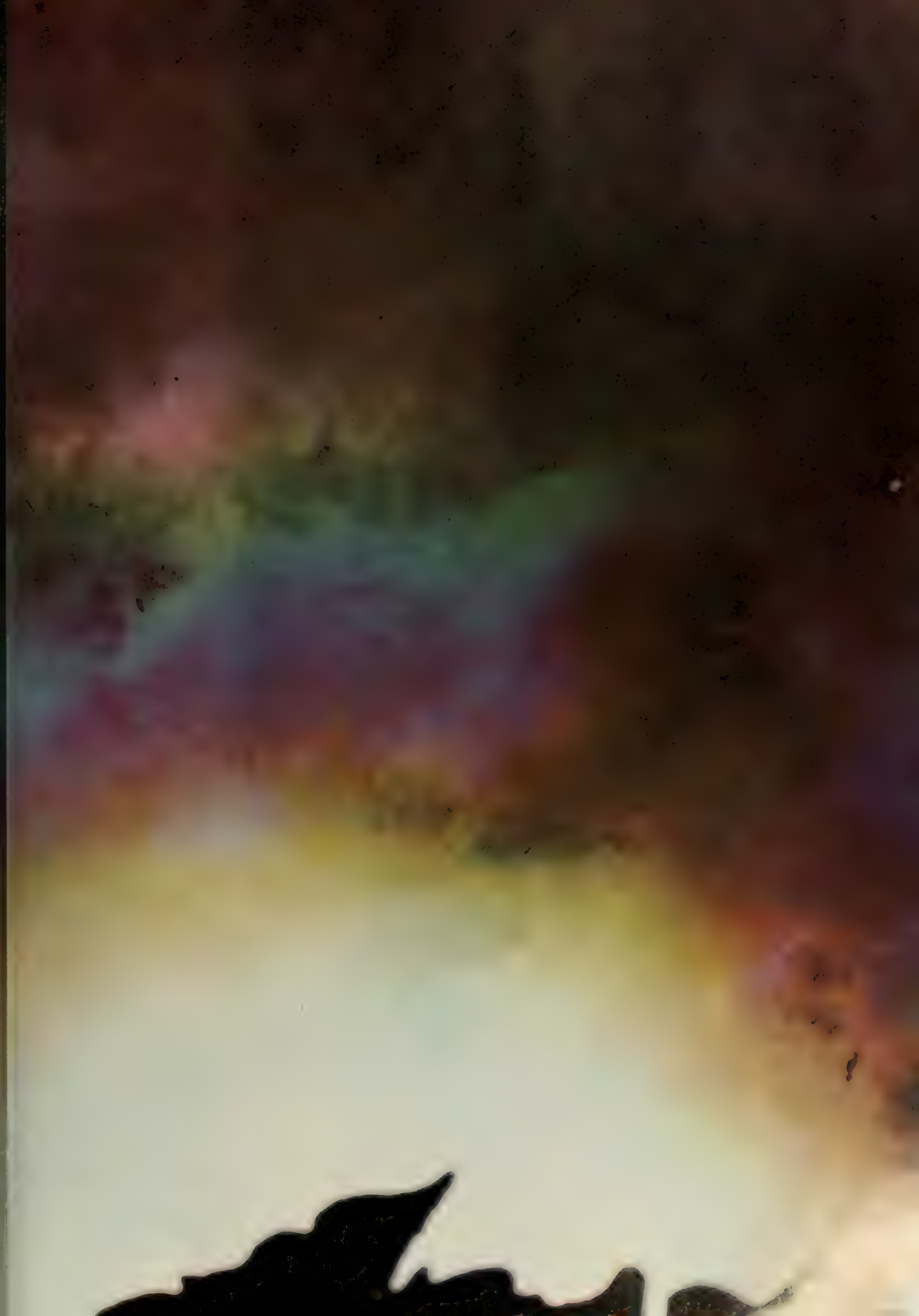
In all probability, the clouds are opaque to sunlight all the way down and the surface of Venus is in darkness. If the lower clouds are transparent, however, there would be a number of novel optical effects awaiting the first explorer on Venus. Rayleigh scattering would be very exaggerated; all colors would be strongly scattered and the

Continued on page 96

A solar corona splashes color across a summer cloud. Leaves of a tree, at bottom, block out the sun itself.

Late on an overcast day, ice crystals form blotches of light called sun dogs in the halo around the sun

© Alistair B. Fraser 1970



People's Art

by Robert Sommer

6th. St.
Love
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Society may design for uniformity and pass laws for conformity, but it cannot confine the spirit of caprice, which rebels colorfully

Chicago—Efforts by a group of citizens to plant a tree in Joyce Kilmer Park—named for the author of the poem "Trees"—were thwarted by police yesterday. The 49th Ward Citizens for Independent Action tried to plant an oak sapling, but police arrested their leader. They said that only the city is allowed to plant trees in parks.

The design of the man-made environment can be so tight and confining that it leaves no room for expressions of individual identity. But sooner or later, like grass growing through cement, these marks of individuals or groups break through the totally designed environment. One manifestation of individual expression is people's art—the beautification or improvement of public spaces without the official approval of the public authorities. Examples include vacant lots converted into playgrounds by neighborhood residents, construction-site fences that have become graffiti galleries, people's gardens and people's trees, junk sculpture along the roadway, and driftwood sculpture along the shoreline. The scale ranges from a couplet on a toilet wall to a six-story mural on Boston's South Side.

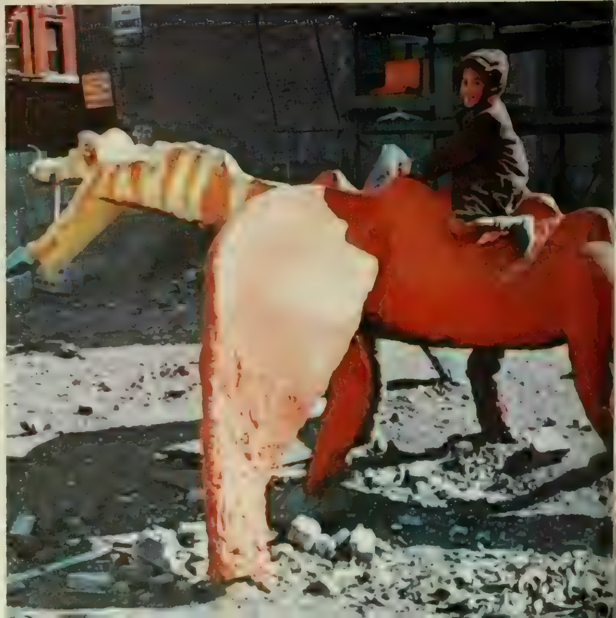
The hallmarks of people's art are anonymity, fluidity, and neighborhood identification. Often the identity of the artist is unknown and becomes a matter of local folklore. On the driftwood sculpture of the Emeryville, California, mudflats, I have never seen a person title his work or place his name alongside it. In this he differs from those painters of rocks along public roads who seem primarily interested in letting the world know who they are, where they come from, and to which team or gang they belong. The materials used in the

Revolting against th
blight of yet anothe
rubble-strewn, vacan
lot, these residents o
New York's Lower Eas
Side demonstrate how t
unofficially beautify
slice of local cityscap
by constructing a
animal play-sculpture

Emeryville sculpture (discarded tires, plastic bottles, driftwood) and the anonymity of the artists indicate respect for the dismal setting—the stillness and ugliness of the eastern shoreline of San Francisco Bay, raped by industry and freeways alike.

These productions have a fluid quality lacking in formally designed works of art. The people's parks that have sprung up in various cities are constantly changing. When I visited one in Minneapolis, built by the residents of Dinkytown as a protest against a drive-in restaurant that would have changed the character of their neighborhood, it contained a large cross in memory of the Kent State students. The heterogeneous layout of people's parks invites the visitor to add his own flower patch or bench or sculpture. When someone writes a poem and publishes it in a magazine, it stands as a completed work of art. But when a man writes a poem on a construction fence, he expects others to add to it.

Not as arbitrary as formal art, street art usually incorporates existing features of the landscape. The still-operating People's Park Annex in Berkeley, California, used litter from the area—discarded car seats for benches and old tires as swing seats. The formal work of art, generally the product of an artist's studio, tends to ignore existing features of the surroundings. For example, a mural in the Sacramento State College cafeteria has an Aztec theme. It is painted around a wall thermostat, which simply remains



suspended between two natives. A folk artist would undoubtedly have incorporated the thermostat into the mural, making it a woman's breast or a piece of fruit in a basket.

The most creative graffiti build upon existing features of the landscape. Along the cement embankment of the Los Angeles River, hinges of storm drain outlet covers form the ears in a series of cat faces. On several occasions the city fathers have painted over the faces, but each time, the many-lived cats came back. A sinuous mural in the Architecture Building at Berkeley began with a doorstop as the nose and eyes of a badger. The little animal was then surrounded by a fantastic landscape that climbed three stories to culminate in a gigantic sunburst at the top of the stairs.

These direct expressions of the need for beauty and personalization raise the question of whether it is possible to distinguish between people's art and vandalism. This is indeed the issue raised by the authorities who consider people's art a step toward anarchy and an invitation to environmental degradation. Is it possible to differentiate between someone decorating a dead tree stump in a slum neighborhood and a young boy carving "C.K. loves Z.B." on a tree in a state park? Although both acts represent the utilization of public space for private expression and communication with others, the intent of the two people is different. One would hope, although there is no guarantee, that the tree painter desired to brighten the cityscape and counteract the drabness of his surroundings. The tree carver violates the anonymity of the true street artist, and his message, although accessible to any finder, was probably directed specifically to his girlfriend. The intention of the artist to beautify the landscape is probably the major way of differentiating people's art from vandalism or environmental desecration.

A jury distinguishes between murder and manslaughter on the basis of the defendant's motives. I am not completely satisfied with something as subjective as the artist's intentions as the sole test of people's art, but it is probably the best criterion that we have. The boy who sprays a peace sign on the school wall or chalks the name of his gang on a building is trying to express himself, to communicate something to others, but he is not specifically intent on beautifying or improving the environment.

Because these artistic incursions of public space are illegal, they are usually performed at odd hours by an underground group or a single individual. The people's playground in Gladsaxe, Denmark, was put together in parts over a period of several days and then assembled at 3:00 A.M. The Plant Sciences Building at Cornell was "attacked" one night by the Guerrilla Graphics Group, who painted brightly colored designs in hallways and corridors. The secrecy involved in such activities necessarily means imperfect democratic decision making. It is not possible to poll all the occupants of the housing project about the sort of playground or mural they want if there is a risk that the authorities will quash the venture before it begins. It is much easier to defend a playground or park once it is completed than during its beginning stages.

People's gardens and murals must be looked upon, not as the pinnacle of democratic decision making, but as the failure of the decision-making process of the larger society to take into account the interests of user groups. In the Gladmer public housing project in Regina, Canada, a tenant is prohibited from owning pets of any kind, from planting a garden, and from placing any form of play apparatus or even a playpen for his children on the portion of land adjacent to his own apartment—land that the tenant himself must maintain. Under such conditions the appearance of a people's playground or garden seems both inevitable and desirable.

Public officials in several cities have taken a cue from street artists and obtained civic support for street decorations and public gardens. David Bromberg, a 36-year-old urban planner in New York City, persuaded landlords to let artists paint murals on building façades at nine locations. Several months ago the Museum of Modern Art held an exhibit of color slides of the murals. The same practice has been followed in Boston, where the city has supplied both paint and encouragement to brighten otherwise drab surroundings. The result has been more than twenty large murals, most in predominantly black neighborhoods, with themes emphasizing black identity and aspirations.

People's art raises important issues about the degree of user participation necessary for an acceptable quality of life. According to psychiatrist Matt DuMont, "The extent to which a person can influence his environment will determine his ability to perceive himself as a separate human being." An account of the first People's Park in Berkeley stated that its importance for the young people lay not simply in its status as a park or its location but in its being an outgrowth of their own labor and decision making. To be fully human, one must create as well as choose, make things beautiful as well as admire beauty.

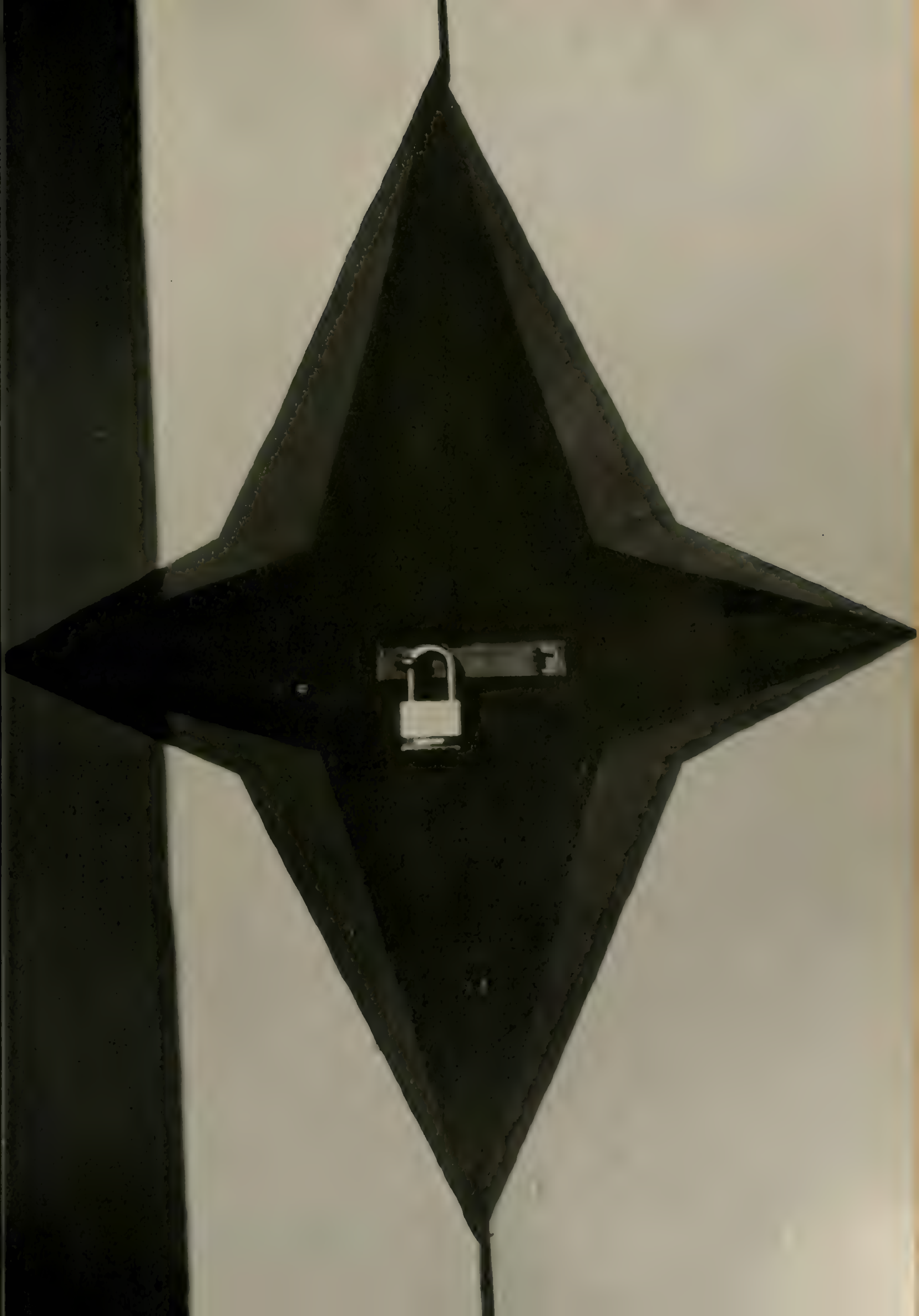
Some architects go so far as to select their client's dishes, silverware, and ashtrays; and interior designers would prescribe desk size, chair style, and the model of desk calendar to be used in an office. A passive client may submit to the designer's expectations, trying to shape himself to fit the building, but after occupancy, individual and corporate subversion of the designer's plans will probably result. The solution is not to eliminate planning but rather to plan for freedom. However comprehensive a design plan is, it should leave opportunity for the individual to exercise options in creating environments that suit his unique needs. A man has to win a battle [illegible] If his office location, desk [illegible] drapes are selected for him, [illegible] he should be able to choose his own chair. Designs must allow for elbow room and foot room, for people to be creative forces in their environment, rather than components of a design scheme. Good planning permits—in fact, encourages—this freedom.

In the best cases personalization enhances an over-all plan. In the dormitories on my own campus at the University of California, Davis, students are given paint and brushes at the beginning of the year and are allowed to decorate their own rooms and to work cooperatively on the halls and corridors. A similar procedure could be applied on a larger scale to a city neighborhood. Here an elected body of local residents might be given authority over the esthetics of the visual environment, including sign ordinances, the color and style of light fixtures, hydrants, and billboards. There seems little reason why all lampposts must be dark green or gray, particularly if the neighborhood residents prefer warm colors. In San Francisco, unemployed youths constructed a Japanese-style minipark and meditation center, complete with rock garden and Japanese-style bridge.

I was delighted to find that the neighborhood park on Olvera Street, a historic Mexican–American neighborhood in Los Angeles, contained the same style of tree sculpture that I had seen outside Mexico City. The workmen who maintained the center strip on the highway between Mexico City and Cuernavaca had shaped several trees to form birds. On Olvera Street a local gardener shaped the trees to resemble circus animals. Why must the trees and bushes in neighborhood parks all be maintained according to the same downtown standards of neatness and symmetry?

Most American cities could benefit from Amsterdam's experience with its allotment of people's gardens along the railroad tracks a
canal banks. Contrast these ne
flower-rimmed plots with the litt
strewn open sewers along the ra
road tracks into New York Cit
and one realizes quickly that letti
people use public land has to
preferable. If allowed to unfol
people's art lets bloom the creati
ity and artistic expression crush
by the totally designed environme

A padlock on a
abandoned New Yor
tenement, right, ge
the decorative limeligh
The cat faces, belo
disguise a series
storm drain covers alo
the Los Angeles Rive

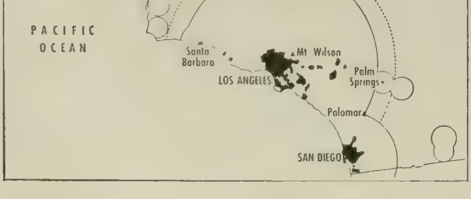


Sky Reporter

Light Pollution Some of this country's largest telescopes are slowly being blinded by the lights of the relentlessly expanding cities around them. The giant reflectors that made astronomical history will have to be moved or become history themselves. The 100-inch telescope at Mt. Wilson has been overrun by Los Angeles; the 120-inch Lick telescope on Mt. Hamilton is losing effectiveness as development pushes south from the San Francisco Bay area; and even the 200-inch Hale telescope on Mt. Palomar—still the largest in the world—is being hurt by both San Diego and Los Angeles.

The great telescopes are unique, not because they magnify objects, but because they can gather enough light to photograph extremely faint, distant objects, objects so far away that they can tell us what the universe was like billions of years ago. But the great mirrors gather all the light that reaches them, and little by little the images of distant galaxies and quasars are being lost in the loom of street lights.

The problem is not unique to California. The rapid growth of Tucson, Arizona, is threatening four major observatories, including a 150-inch telescope still under construction. The observatory directors have asked the city council for unprecedented help in controlling light pollution. They want new streets to be asphalt rather than concrete; shields on street lights to prevent any light from escaping above the horizontal; and special filters on the lights to screen out violet and ultraviolet components that do not add much to the illumination but seriously interfere with astronomical work. The city, which prides itself on being an astronomical center, is taking the suggestions seriously.



Observatory sites are chosen to get the most out
any given telescope. Criteria include percentage
clear weather, clearness of the air itself, minimum a
turbulence, and freedom from artificial lights. T
ideal site is at least one mile above sea level, whi
automatically places the telescope above a good de
of bad weather, air pollution, and turbulence. Becau
few locations meet all the criteria, major observatori
have tended to cluster at the best sites—southern Ca
fornia, Arizona, and lately, Cerro Tololo in Chile.

Now increasing light pollution is severely limiti
the choice of sites in California and Arizona. The a
companying map gives some idea of the problem
southern California. The solid line encloses the area
which the sky is made unacceptably bright by ar
ficial light. The standard is based on existing con
tions at Palomar, shown on the boundary. The brok
line indicates how much farther this zone is expect
to extend by 1985.

The map is the work of Merle F. Walker, who
rected the search for a site for future Lick Observ
tory optical telescopes and reported his findings in t
*Publications of the Astronomical Society of the P
cific.* His team spent two years comparing sites alo
the coast with inland alternatives before settling
Junipero Serra Peak, 5,862 feet high, just outside t
1985 line. In future years city lights will make si
selections even more difficult.

Then there's the smog problem. . . .

NASA Does It Again The national space agency is ba
ting .333 in launching orbiting astronomical observ
tories—a good average in baseball, but not so good
satellite launching.

The first time up, in April, 1966, the space telesco
made it into orbit and then suffered an electric
breakdown. The second, launched in December, 196
was still working perfectly two years later, having o
erated for at least twice the design time. Then la
November 30 a third was launched, but never made
into orbit: a protective nose shroud failed to jettis
and the vehicle was too heavy for the boosters.

Ground-based astronomers tend to get upset wh
the launchings fail. Last November's effort cost a co
$98 million. The burned-up remains of the satellite a
believed to have crashed somewhere in Central Afri
or in the Indian Ocean. Today there are only a handf
of large telescopes in the world, demand is greater th
ever, and some of the existing instruments are bei
rendered impotent by the encroaching lights of su

ɔia. The same $98 million would have bought five v Palomars.

But when they work, the space observatories see ngs that no ground-based observatory of any size or t will ever see. The OAO-2 has mapped the universe ultraviolet light; studied certain young stars that it most of their radiation in the ultraviolet; dis- ered ozone on Mars and a million-mile hydrogen ud around a comet; has found that ordinary gal- es are much brighter than expected in the ultravio- and that the hottest stars are burning up their lrogen even faster than had been believed.

ino Acids in Meteorites The best evidence yet that ino acids are truly present in some meteorites and not just the result of contamination on earth has ne from a meteorite that fell near Murchison, Aus- lia, in September, 1969.

No one is saying that the amino acids, if they really extraterrestrial, were formed by living organisms. oratory experiments in chemical evolution show y can be formed by inorganic processes. But the covery of extraterrestrial amino acids, formed by process, would be a giant step for chemical evolu- n.

Amino acids are the building blocks of proteins, the nplex, nitrogen-bearing molecules essential to the icture and functioning of all living things. While nts and some bacteria can make their own amino ds out of relatively simple inorganic compounds, mals cannot synthesize them and must include them their diet.

Scientists generally believe that life arose sponta- ously on earth—not overnight, as in the maggot ex- riments discredited by Pasteur, but through a proc- of chemical evolution that took millions of years. nino acids were created in the laboratory not quite enty years ago by reproducing conditions believed have existed on the primordial earth. In the last veral years the scientists have found that chemical olution probably started long before the earth even med; radio astronomers are discovering molecules ever increasing complexity in interstellar space.

When the earth did form some 4.5 billion years ago, iny of the chemical precursors of life may have al- ady been present. The story of terrestrial life begins, t on earth, but in the violence of a supernova ex- osion that produced the elements of life, and in the pths of space where these elements began to link to compounds.

Apparently the space between the stars is filled not only with hydrogen and dust but also with water, ammonia, hydrogen cyanide, formaldehyde, carbon monoxide, cyanoacetylene, formic acid, and methyl alcohol. Radio astronomers are even now seeking the telltale emissions of amino acids.

They may have been found already in the Murchison meteorite, a stony fragment that revolved silently through interplanetary space for untold years. The amino acids are present beyond a doubt; the question is whether they were there before the meteorite plunged to the earth's surface.

Amino acids have been reported in meteorites before, but the reports have generally been discounted; the amino acids found were exactly those also to be found in fingerprints. With the Murchison meteorite, however, the situation is very different.

Most important are the optical properties of the amino acids found in the meteorite. Many substances are optically active: they rotate the plane of a beam of polarized light when the beam is passed through them. The rotation can be to the left or right. The important point is this: in nearly all living material found on earth, the amino acids (including those found in fingerprints) all rotate the plane of such a beam to the right. But the amino acids in the Murchison meteorite are almost evenly divided between left rotators and right rotators.

The investigators feel they are able to exclude fingerprints as the source because the distribution of the individual amino acids is very different. Serine, the amino acid most abundant in fingerprints, is present in the meteorite. But other amino acids, never found in fingerprints, are present in the meteorite in much larger quantities than the serine. The distribution of amino acids in the meteorite is entirely different from that in fingerprints.

The analysis was made by a team from the exobiology division at NASA's Ames Research Center; the geology department at UCLA; and the Center for Meteorite Studies at Arizona State University. Reporting their results in *Nature*, the team, led by Cyril Ponnamperuma, concludes that the meteorite amino acids are of a nonbiologic origin because two of them are not found in living systems on earth. Unwilling to claim too much in a very controversial field, they say only that the distribution and properties of the amino acids (and some hydrocarbons) "support the contention that the organic molecules are abiotic and possibly extraterrestrial in origin."

JOHN P. WILEY, JR.

Celestial Events

The waning gibbous moon rises well after sunset in mid-February and becomes the last-quarter moon on the 18th. New moon occurs on the 25th, and the waxing crescent appears in the evening sky before the end of the month and in early March. First-quarter moon occurs on March 3, and full moon is on March 11.

The bright planets continue to dominate the morning sky through the end of February and into March, with Venus and Jupiter quite bright and prominent; Mars in good position but somewhat dimmer. Venus is dimming from its greatest brilliancy early in the year, but it is still the prominent object of the southeastern sky from several hours before sunrise through dawn. Mars is higher and to the right, approaching first magnitude in brightness, clearly yellow-red in color. Jupiter, second in brightness only to Venus, rises at about midnight and climbs to prominence in the south by dawn.

Saturn is the only planet in the evening sky, appearing well up in the southwest at dusk, easily found among the faint stars of Aries. The planet sets well before midnight.

February 18-19: The waning crescent moon rises after Jupiter and follows the planet up the sky during the after-midnight hours, separating slowly from the planet as dawn approaches.

February 19: Look for the reddish star Antares near the crescent moon in the morning sky. Jupiter is to the right and higher than the moon. Antares is quite close to the crescent, just to the right, separating slowly as both moon and star move up the sky.

February 19-20: The crescent moon passes Mars late in the day on the 19th. Mars will be to the left of the moon in the morning sky of the 19th and about the same distance away but to the right and above the moon on the morning of the 20th. Antares, about as bright and red as Mars, is also about as high in the sky at daybreak, but to the right of the planet.

February 21-22: The waning crescent moon, now very slim, passes Venus before midnight on the 21st, when both are below the horizon. Venus is to the left of the moon on the morning of the 21st, to the right and higher but closer to the crescent on the 22nd.

February 25: A partial eclipse of the sun occurs over all of Europe and northwest Africa. Perigee, when the moon is nearest earth, occurs eleven hours after the new moon. The normally high spring tides accompanying the new moon will be enhanced by the relatively close moon.

March 1-2: Saturn can be found above and to the left of the crescent moon on the evening of the 1st. It will be to the right of the moon on the evening of the 2nd.

March 6: Mercury has been in the morning sky, but rising too late to be seen. Today it passes behind the sun in superior conjunction and enters the evening sky.

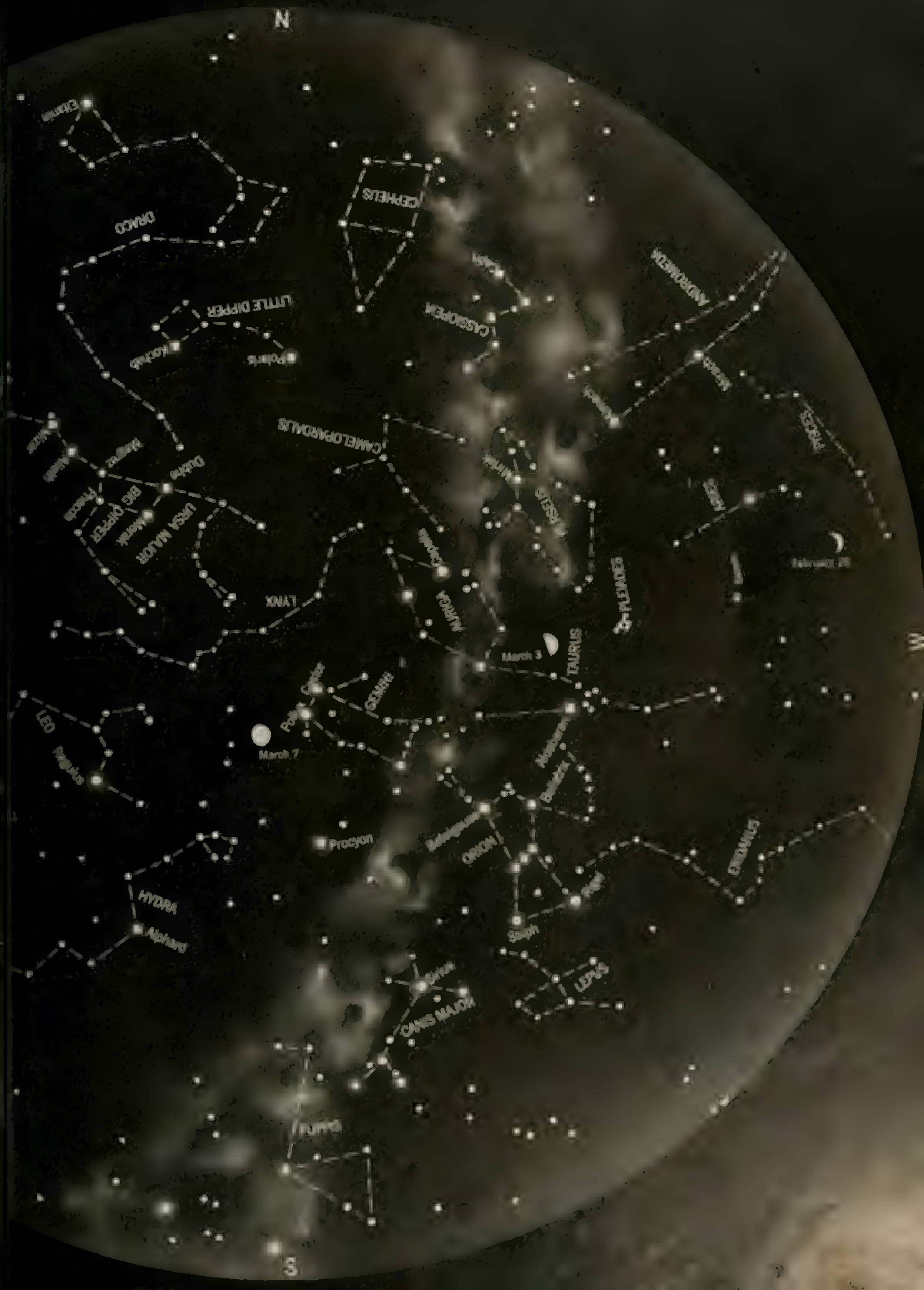
March 9-10: The moon moves through Leo on these evenings, passing very close to the star Regulus. Look for the star to the left of the moon on the 9th, to the right of the moon on the 10th.

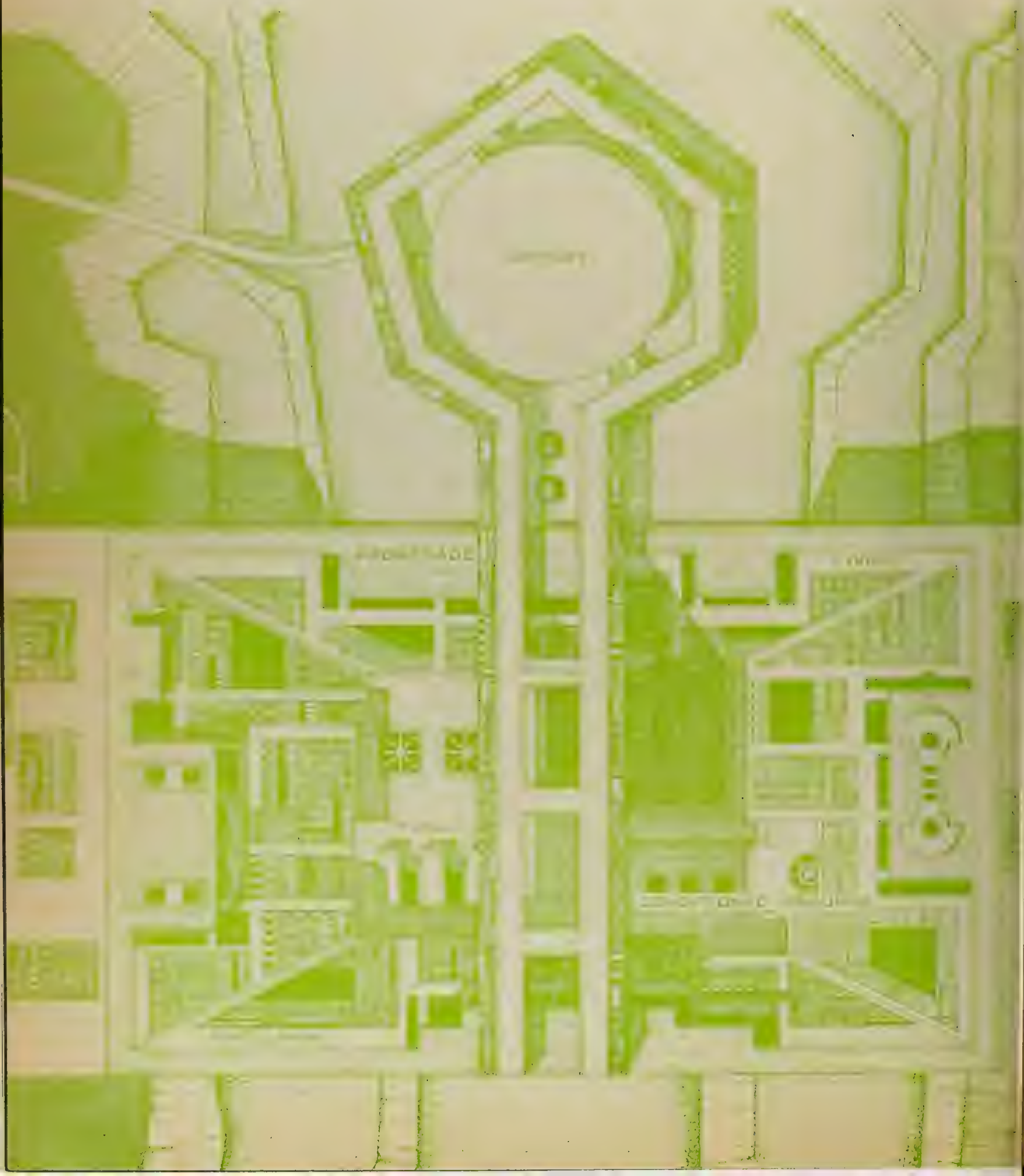
March 12: The full moon occurs within an hour of apogee, when the moon is farthest from earth.

Thomas D. Nicholson

★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky. The map is for 11:15 p.m. on February 15; 10:20 p.m. on March 1; and 9:25 p.m. on March 15; but it can be used for about an hour before and after those times.

OTES
Arcturus
VIRGO
Spica
March 14
CORVUS


N
Eltanin
DRACO
CEPHEUS
LITTLE DIPPER
Kochab
Polaris
CASSIOPEIA
ANDROMEDA
CAMELOPARDALIS
Mizar
Alkaid
Megrez
Dubhe
Phecda
BIG DIPPER
Merak
URSA MAJOR
Mirfak
PERSEUS
PISCES
February 28
Capella
AURIGA
LYNX
PLEIADES
March 3
TAURUS
Castor
Pollux
GEMINI
March 7
LEO
Regulus
Aldebaran
Bellatrix
Betelgeuse
ORION
Procyon
Rigel
ERIDANUS
W
Saiph
HYDRA
Alphard
Sirius
LEPUS
CANIS MAJOR
PUPPIS
S


FRONTAGE

The State of the Species, February 1971

Beyond Civilization

by Paul Bohannan

A Natural History Magazine Special Supplement

On the Past, Present, and Future of Man

The intense crisis that threatens the world we live in seems to have come upon us so suddenly that it is understandable that we frantically search for immoralists to blame or scapegoats to sacrifice. When we were children, and when some of us were young adults, we saw a disturbed world before us, but at that time the malady was focused so that it seemed to be the result of human error—we could still blame individuals, specific leaders, specific peoples. There was little to indicate to us, in our innocence, that civilization itself was threatened—that we were witness not merely to human moral weakness and error, but to an overwhelming evolutionary process. Yet today we know that civilization itself is threatened—threatened by itself.

But which civilization? We must repeatedly ask what civilization itself is. Not just our civilization, but civilization as a process: what it provides for us and what its future may be. To examine the crises of civilization one must go back to the idea of culture, and man's use of culture as his device for adapting to the world he lives in. Culture is the technical term, coined by anthropologists in the nineteenth century, to refer to the "artificial" extensions of the human being that allow him greater control over his own environment, over his social system, and ultimately, over himself. Culture is, to make an analogy, what the medical men call a prosthesis—an extension of the animal that makes it possible for him to do things he could not otherwise do. Artificial limbs, false teeth, and eyeglasses are common prostheses in the modern world. But by analogy all of culture can be seen as the prosthesis of the human being—an animal who specialized in brain and central nervous system and developed, through their use, extensions of himself that allowed him to remain an otherwise nonspecialized animal, without built-in fighting equipment such as claws or horns or canine teeth; protective devices such as fur, natural camouflage, or fleetness; indeed, without any other form of physical specialization to give him any great advantages toward survival.

Culture, in other words, comprises all the things and devices—including the nonmaterial, such as myths and beliefs and stories—that human beings create to enhance, protect, or express themselves. Culture has, in the course of evolution, become the peculiar (but not unique) property of human beings, and human specialization in culture (like the specialization of tigers in saber teeth or of giraffes in long necks) has been the means by which man has survived and aggrandized himself on the planet. By it he must (and will) either survive or perish.

Today we know that culture is a two-edged sword. The very while that it allows us to express ourselves more fully, to explore social organization more broadly, and to master our environment more thoroughly, it creates situations of alienation, tyranny, and ecological imbalance. It seems an irony when we realize that only by cultural means can man overcome

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the evil effects of culture and yet retain the good effects. Once he has started on this road man must learn more about how to get from himself the best and most enjoyable of lives; he must learn more about human social organization and how to control it without what we see as immoralities, even when we do them; and he must learn more about the physical world in which he lives so that his accomplishments will not so alter the earth as to make it uninhabitable.

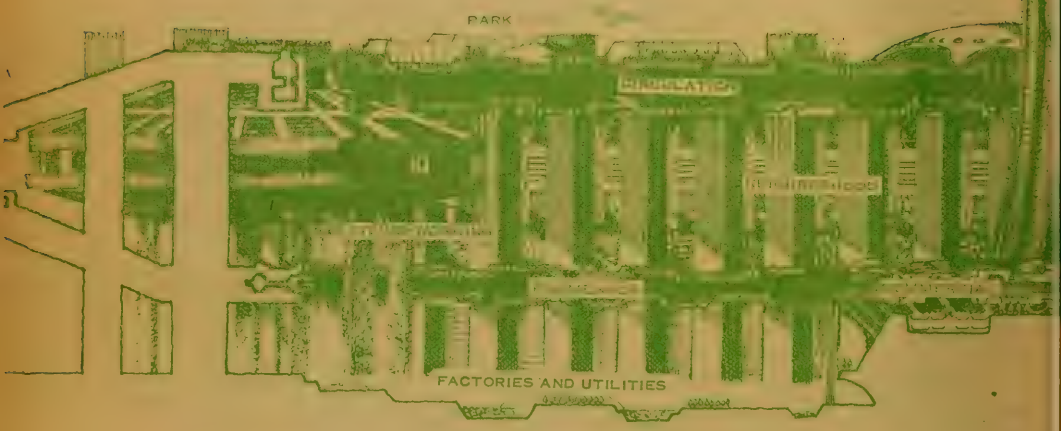
Man, through several million years of evolution, is committed to living as a cultural being. Only in the last few decades have we realized that culture must be controlled by man himself, and his evolution altered to special kinds of cultural activities, if he is not to become extinct from overspecialization—from blind overspecialization in culture. There is, at this stage of the game, literally no answer except to treat the blindness, to have the courage to see.

The source of the human (and hence cultural) problem is an irony—man is born an *individual, social* animal. In that contradiction lies the basis of our neuroses, our social problems, our moralities and immoralities. Since intelligence is brought to the survival of both the individual organism and the species, it is possible for the individual to act in what seem to be his own interests at the very time he is acting against the interests of the species. It is this irony that every society must, with one degree or another of success, organize itself to deal with.

But even the organization is ironic, for no two intelligences see it quite the same way. Since man is a social animal and has opted for a cultural mode of self-preservation, all human social groups consist of parties (sometimes individuals, sometimes small groups) interacting in terms of the available culture. Each social group—from the family to the nation, indeed, from the marriage or the mother-child relationship to the United Nations—has a cultural tradition. That tradition changes as new cultural items are invented by members of the group, or as members of the group come into contact with other people whose repertoires of cultural items are different from their own. Therefore, culture is not only handed on from generation to generation, it is also handed "sideways" from one social group to the next. In today's world, we live in a culturally privileged time because items from so many different cultural traditions are available to large numbers of people—indeed, prosperity can in one sense be gauged by the kind and amount of human culture available to a group. But so, obviously, can the potential for disaster. Culture grows as the group flourishes, and the group grows in size as culture flourishes. And then, suddenly—at least it always seems sudden—there is a vast disparity between the capacities of the available culture and the group it serves. The culture that was adequate for yesterday is inadequate for today and disastrous for tomorrow. If there is a law of culture, that is it.

With the fury of an inspired visionary, architect Paolo Soleri of Scottsdale, Arizona, plans cities of the future. These cities, which he calls arcologies, are unlike anything yet conceived by man. Their construction would bring man into a new civilization.

Some 10,000,000 people would work, enjoy—virtually live their whole lives—in the four cities shown in this supplement. The drawings come from Paolo Soleri's book, Arcology: The City in the Image of Man, *MIT Press, 1969.*

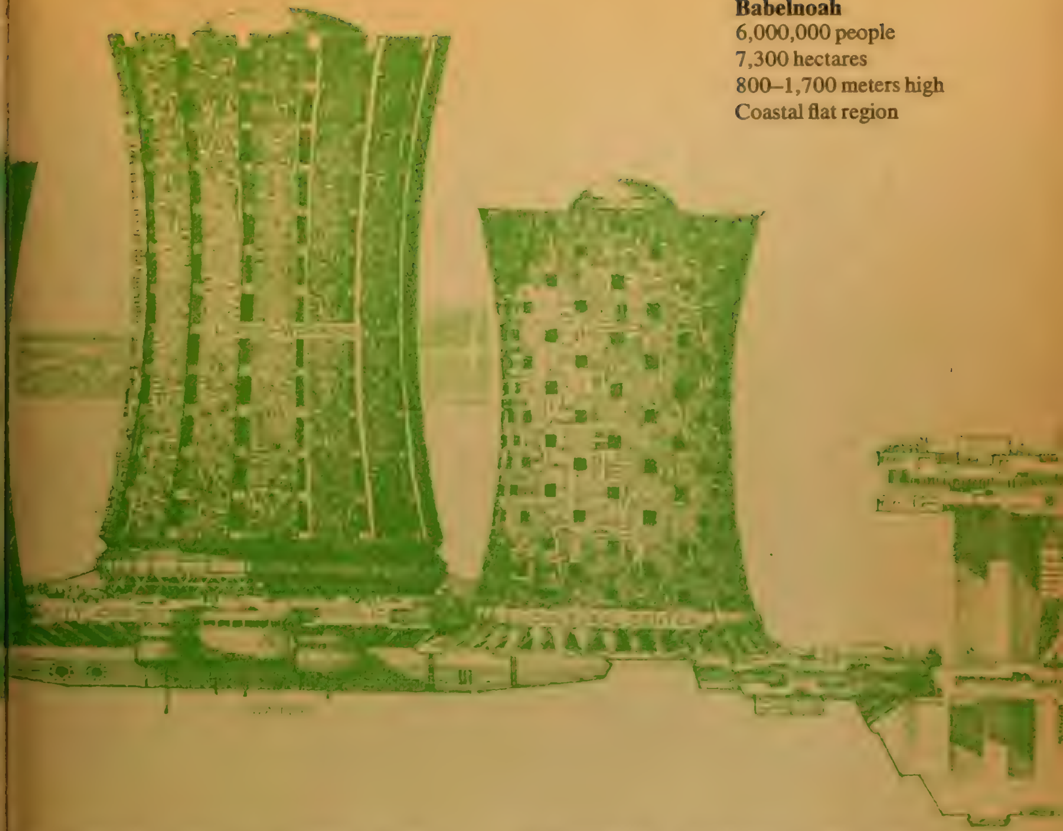


And so it has always been. But today our ironic harvest seems particularly bitter because there is so much *good* culture, judged by our own inward awareness of what is good for us. And, worse, the bad culture is an epiphenomenon, or so it seems. Slowly we must realize that the problem of evil is with us again. In Roy Rappaport's words, it takes the form of the "evolution of maladaptation."

Actually, of course, the problem of evil was never absent, but for a while evil seemed to be attached to individuals, to institutions. And now, again, we see it as the other side of our natures—all our natures. In spite of villains, I too have an evil dimension. Existing culturally creates evil. Culture is, indeed, as the Genesis myth puts it, the knowledge of good and evil. We were thrown out of the garden we wish had once existed into a hell we wish did not

For the dynamics of culture work in ways that are beyond the purposes of men, whatever they may be. Culture becomes something i itself, something beyond man. Ultimately, i becomes, in the inspired phrase of Jules Henry, culture against man. One's own prostheses turn on one's very self. That is the price one must always pay for prostheses, medicines, drugs, or even love.

When a small group of human beings adapts and successfully adjusts to its environment, the group survives. If its adaptation i unsuccessful, the group perishes: to survive, its members change and adapt in different groups or they too will perish. If the cultural adaptation is successful, then the group is safe, it members perhaps comfortable. In response t



Babelnoah
6,000,000 people
7,300 hectares
800–1,700 meters high
Coastal flat region

the animality in us and to thousands of millions of years of evolution, the group, in its comfort, grows larger. As the group grows larger the available culture is "stretched"—it is like putting water in the soup to feed unexpected guests. Such diluted culture does not serve as it once did; the situation is no longer that for which it was designed and in accordance with which it evolved.

Three things can happen when culture is stretched too far: the population growth can be checked, either by a natural disaster of some sort or by a population policy; the group can break into two or more groups that separate, and each of them can begin again the process of achieving first optimum, then maximum, and finally destructive growth; the third choice is to invent new culture—new ways of coping with the environment, new ways of dealing with each other, of experiencing the human animalness of us.

Obviously, only those groups that choose the last way survive in the long run. Breaking into several groups, cell-fashion, works only so long as the ecological carrying capacity of the world is not seriously affected.

Thus the real problem arises because man is clever and can devise ways and means of beating the system—for short periods of time. The use of fire, the use of metals, the use of more complex hierarchies to achieve larger social organizations, all of these cultural discoveries and many others have allowed larger populations to survive and multiply, outgrowing the culture that spawned them, and in a sort of cultural Malthusianism, creating worse problems than they solved. Worse because so many more people are involved, and because they are more helpless the further they are removed from a simple ecological position in nature: man as a hunter and gatherer was just another animal.

Civilization

There comes a point in this continuous growth of culture when those traits emerge that characterize "civilization": a large enough population to have something resembling an urban agglomeration, a highly developed division of labor with concomitant specialization in a stratified society, food production rather than hunting and gathering, the form of government known as a "state," a calendar and basic mathematical knowledge, written records. They always go together—and the absence of any of them makes classification as a civilization doubtful. Indeed, each of the characteristics is a partial solution to the tot problem that emerges when the conditions precivilization are reached. These conditio are: too many people; lack of predictabili and safety; a concern with status; too litt to eat; struggles to understand the nature ourselves, our world and our place in it; a attempts to store knowledge in some w other than in the limited and untrustwortl human mind.

The characteristics of civilization all appe

together because they are part of the same thing: a cultural struggle to solve problems created by culture.

Yet, the list of the pressures of precivilization reads like—in fact, it is just another version of—a catalog of some of the gravest problems of our own time: overpopulation, decay of the environment, status systems riddled with devices that keep us from utilizing or appreciating human potential, starvation for many on the horizon, getting rid of the garbage, the tyranny of government and industry, the growth of knowledge beyond our means even to index, let alone assimilate, it. In every case, it is the same problem that we had before, given a characteristic twist by the fact that civilization was an answer to another and older version of the same problem.

Obviously, we stand on the threshold of postcivilization. When we reach solutions to today's problems, the society and culture that we will have built for the purpose will be of a sort the world has never seen before. It may be more, or less, civilized than what we have, but it will not be civilization as we know it.

Civilization itself, then, is a response to a culture crisis—a response taken a number of different times in the history and prehistory of human society. Civilizations either decay and fold up when solutions are inadequate or else—an almost unbearable irony—they have to alter themselves beyond recognition because of their very success. We are now in the middle either of a crumbling civilization or of one of those giant evolutionary steps that we cannot see because the goal is incomplete and clouded, in the very atmosphere around us.

So—what about these characteristics of civilization? It is easiest to discuss them if we begin with those that we think, perhaps wrongly, have the least effect on the more intimate aspects of our lives.

Writing. Writing is (except for a few *aides memoires* such as the knotted strings called *quipu* in Quechua, the language of the Inca civilization) the first device other than human minds and relationships for "storing" culture. Writing opened an entire new era because (to use the jargon of the computer age) the storage and retrieval problem was solved in a new way. Writing solves the storage problem better than the retrieval problem. Nevertheless, writing makes it possible to store vast amounts of culture over long periods of time without depending on the constant repetition that keeping it in mind demands. It can be written down and put away—and maybe somebody will unearth it someday. It is this fact—that all of the culture available to a society need not be kept constantly in mind—that leads to the accumulation of the vast amounts of culture, and allows for the cultural differences that the complexity of a civilization demands.

Literacy also affects personalities. In preliterate societies the only people who can become famous and immortal are those who act: heroes in the foreground of action. Literacy lays the groundwork for romanticism—the possibility exists that someday one will be discovered despite the scorn of one's fellows. Thought takes on a new meaning if it can somehow be disembodied momentarily from the thinker. A new dimension of an idea has been perceived, which may even have laid the groundwork of that most monstrous of philosophical separations—the separation of mind and body.

Writing also makes possible a new level of scientific achievement—again because there is no need for one person to know it all or for a complex social group to organize the knowledge orally and to pass it on—a kind of organization found in early religion and in science, particlarly astronomy. Knowledge, in short, was released from the human mind and from the social structure in such a way that it could be called up by both, on demand. Thus, new dimensions in science, as well as in commerce and in literature, were discovered.

Novanoah II
2,400,000 people
2,790 hectares
400–1,600 meters high
Continental shelf or open sea

Calendars and Mathematics. It would seem that, often at least, scientific knowledge begins in calendars, which are among the outstanding intellectual achievements of all civilizations. All people can count days, moons, and summers (or some other season of the year, such as wet seasons in the tropics). In some cultural traditions, people may be taught to count other things instead, particularly rituals or harvests, or even to repeat cycles without specifically counting any events. However, it takes a fair degree of sophistication to divide time into artificial periods such as hours or weeks, which have no natural countable events as their basis. And it takes still more sophisticated views and technology to keep records, even oral "records," in terms of the counted events or artificial units. Indeed, unless there is writing, this last step is usually not taken, even if all the other elements for accurate time reckoning are available. Calendars have been invented and reinvented in several parts of the world, but common to all is that when they are associated with writing, a new accuracy in record keeping can result and the basis laid for the maintenance of historical records. Thus the people who live in these societies can begin to appreciate the nature of history and historical change, rather than the mere cultural norms, sanctioned by remembered and misremembered tradition, of any "present" situation. Time depth is added in the civilization, a mixed blessing because it now becomes possible to control more precisely what information is "remembered" and what is "lost."

Creating a calendar demands some knowledge of heavenly bodies and, ultimately, astronomy. Science in all civilizations seems to have begun with astronomy and moved constantly in toward the self.

In the early days of calendars, as of writing, these arts tend to be carefully guarded secrets, in the hands of a priesthood or a ruling group. Writing and time reckoning give men power; therefore powerful men keep them away from those who have no power, reinforcing the social hierarchy and increasing the distance between the strata. In early civilizations, writing and record keeping are the prerogative of special classes—either privileged classes of priests or else of slaves who are in the immediate power of kings and priests.

Food Production. During the Stone Age, men learned to make the kind of tools that allowed them to hunt large animals. Mankind thus acquired a new capacity for getting food that, in turn, led to a population explosion that, in its turn, meant that mankind was spread over larger parts of the earth's surface, in a wider variety of climates, and with ever more specialized tool kits.

The greatest change, however, came about 9,000 years ago when man turned from hunting large animals to sowing grain and planting roots and to the domestication of a few animals. This agricultural revolution, as it has been called, was not an unmixed blessing, for it introduced the possibility of famine into the world. Before that time famine had existed only in such marginal ecological systems as the northernmost tundra or in overpopulated areas. Even deserts and jungles, as they were exploited by hunting peoples, yielded a secure food supply. Agriculture, however, brought a new kind of dependence on weather, rather than on mere climate to which one can adapt. With harvest came the possibility of crop failure. Storage facilities had to be improved to secure against famine, indeed, even to make a crop last from one harvest to the next when there was no crop failure.

Agriculture was developed in several different parts of the world—in the Fertile Crescent, in the mountain regions of middle America, in the valleys of China, and probably independently in West Africa and the islands of Oceania and New Guinea. In spite of the new danger of famine, a new kind of plenty was created: the techniques of producing, rather than hunting and gathering, food allowed for vast population growth. It also allowed for a sedentary population. Until agriculture was developed, human groups were never sedentary—the only possible exceptions were those that lived on fish and seafood (but Binford claims that the earliest use of seafood dates from no more than 32,000 years ago).

So, agriculture brings sedentary settlement—and, of course, the problem of garbage disposal. Garbage is any product or any by-prod uct of any animal that is not used up as food by some other animal. The more culture, the more garbage—until we turn culture into a device that always eats its own garbage.

However, sedentary settlement also creates the possibility of large populations in a small space, thus supplying another of the requirements for a civilization: large populations in cities or urbanlike agglomerations, to go along with the required specialization of tasks and exchange of goods. Without food production by agriculture, large agglomerations of people cannot be fed.

Trade. Although there have been civilizations without long-distance trade, most have exhibited it. Once specialization has occurred and commercial exchange of specialized craft products and crops has been organized, the need for trade at a distance is felt, and the social niche for traders is ready-made. Trade is made vastly easier by the simplifying mechanism of general-purpose money, and money (but sometimes not coinage) is found in all civilizations marked by trade.

Luxury goods and raw materials acquired by long-distance trade increase the cultural distance between the various strata of society.

Government. When large numbers of people are present in any fairly confined space, new responses and legal, judicial, and military structures are required. Government tasks such as settling troubles and commanding armies become specialized jobs; administrators also begin to be specialists. In the early civilizations, most governments use the sacred authority associated with the religious hierarchy of priests as well as the profane authority of a secular hierarchy. Separating the religious hierarchy and the secular governmental hierarchy is a step that has been taken by only a few civilizations.

Protecting large agglomerations of undefended population from the "barbarians" of the desert or the nomads on the peripheries requires large armies. These armies are, in fact, a response to raiding as a form of parasitism on settled, farming peoples. But what results is a large army. If contracts are to be protected—and no large-scale society can persist unless they are—then the state must have a police organization to enforce the contract law in the absence of any other sanction. Record keeping by governments brings about other bureaucracies. Bureaucracy breeds bureaucracy, and bureaucracies tend to be self-serving rather than to serve those purposes for which they were designed. Governments are always on the verge of becoming unwieldy.

Stratification. We have already seen that, from the earliest times, literacy and education widened the cultural gaps between the strata of society. The presence of religious and governmental hierarchy, whether separated from one another or not, together with the specialization of crafts and industries and the development of trade, means that all the civilizations of which we have any record are stratified societies—some people or groups rank higher and have more privileges than others. Strata may be rigidly separated as in a caste system, or individual mobility among them may be permitted as in an open class system; but between these two extremes there are all shades of variety. These stratification systems are always associated with differences in rights, privileges, and material well-being. The problem of poverty or plenty has haunted many civilizations, and the most astonishing distinctions have been used to separate, classify, and "brand" the members of each stratum.

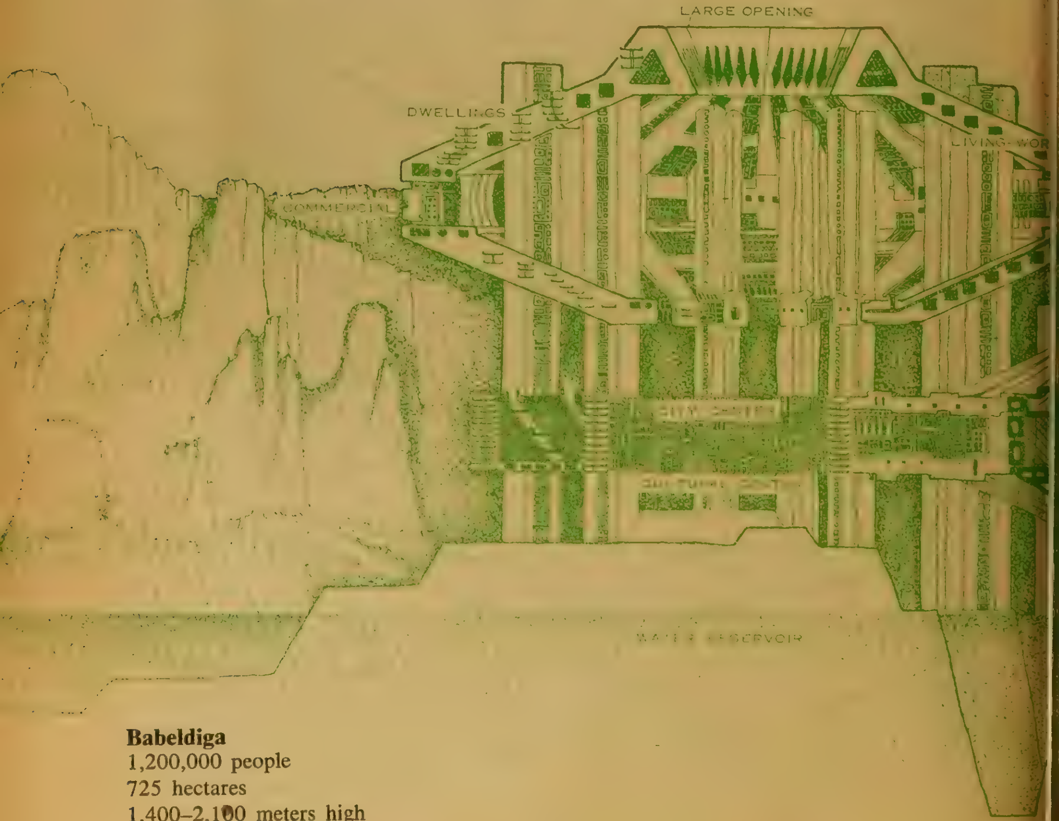
A civilization, then, is a very specialized type of society with a specialized kind of culture. Writing allows expansion of the available culture; science allows its organization. Agriculture and the production, rather than mere gathering, of food allows sedentary agglomerations, and both are prerequisite logically (although they may have grown together in historical time) to a complex division of labor, which means increased production and trade. Innovations in legal and military branches of government, with or without sanctions based on religion, are always present, so that a political mechanism resembling the state occurs. When all of these factors come together, the result can be called a civilization.

Today, with the wisdom of hindsight, we can see that civilizations formed with all their weaknesses, problems, and troubles vibrant.

The Crisis of Civilization

When we achieve postcivilization, or "Phase II civilization," it too, of course, will come bumbling with all its problems intact, even though it may be a while before we recognize them. We know now only that the traits of Phase II civilization will stand as solutions to the problems of Phase I civilizations before they too turn into problems, and human beings again begin to flail about in search of Phase III civilization. Perhaps every age is a watershed. In some places it is possible to see only immense problems, while at other points solutions are emerging. Certainly what we see today is a recognition of solution in a few places, while in most we can recognize only the intense need for solutions.

Computers were developed to solve problems of the "information explosion"—problems of cultural storage and retrieval and of complicated manipulation of that culture at high rates of speed. Computers are extensions

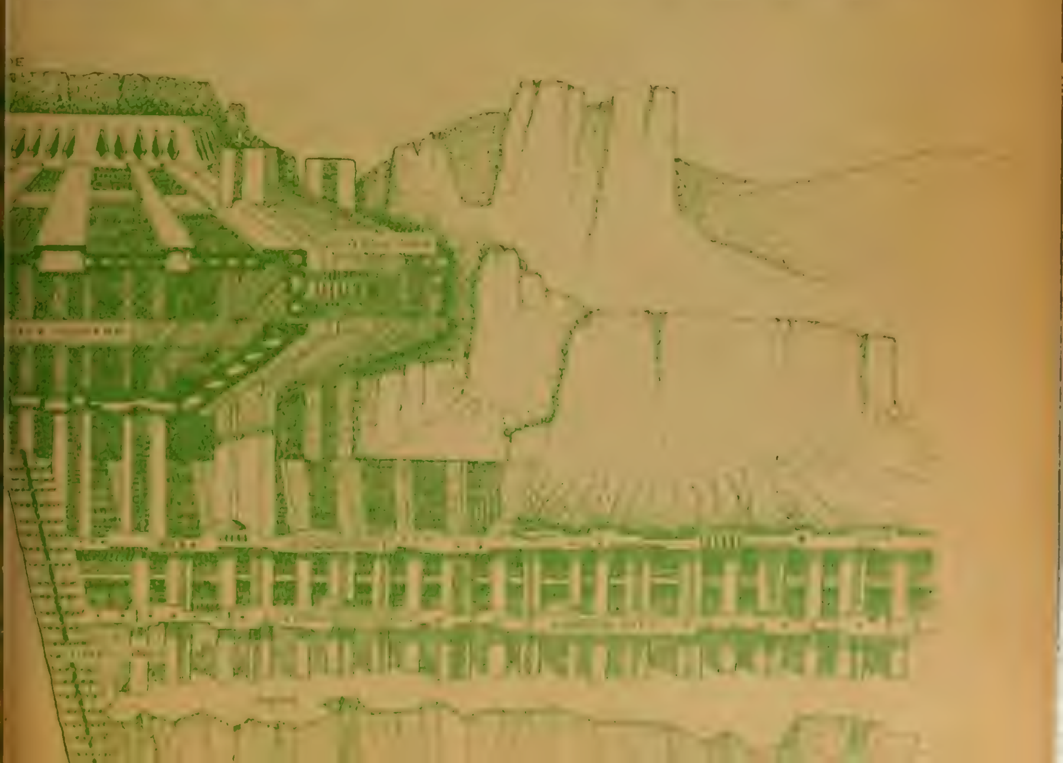


Babeldiga
1,200,000 people
725 hectares
1,400–2,100 meters high
Dam site

of the human mind, as much as eyeglasses or telescopes are extensions of the eye or as culture in general is an extension of the whole body. Computers do nothing but "follow orders," of course. But we do put all the information (culture) into the computer in a form that makes it possible for the computer to carry out instructions. In other words, the culture in a computer is programmed for the limitations and needs of the computer. And the word *program* as a verb has fed back into the general culture: we now know that human beings are programmed to learn languages and indeed to learn culture, that every language demands a programming of information in terms of its categories and rules, and that languages vary about the kinds of things that must be programmed if one is to speak them at all. English, for example, demands programming of the sex of the third person singular; Japanese demands programming of the social status of the second person. Avoiding either leads to stilted expressions, but neither is demanded by the other language.

If computers are to work, culture must be processed to fit their capacities. This processing, like translation or like putting emotions into words, alters the nature of culture, for the simple reason that you must program some matters in a computer "language" (as in any other), while other matters cannot be programmed. We have, thus, altered the nature of culture. And if we are to use the computer for storage and retrieval of culture (which is what a computer does), we should learn to understand it well enough to prepare for its mark on the cultural traditions. Ultimately all kinds of culture will be reducible to mathematical or some analogous kind of "language" for storage in computers. Some of this stored culture will, obviously, be turned back into language before it is used, but some of it can be used by changing the nature or culture of the user. Again, the cultural tradition will bear the mark of the storage and retrieval of culture, transformed into an idiom that fits the boundaries and capacities of a machine.

Computers may never create culture (but



then again, they may, for they are said to write "music"). The point is a quibble when we realize that they do indeed store culture in a form other than human language and that, most importantly, computers are the first means ever found to make one piece of culture interact with another piece of culture outside the human mind. Nothing since writing has been so revolutionary as the computer. It stands to Phase II civilization as writing stands to civilization.

Although we are over the hill on computers —we can see that they are the culture storers, record keepers, and general culture police of the future—we are not so sure when it come to science. Science has by now become a self-perpetuating institution in our society. Just as writing and astrology were the prerogatives of the powerful in early civilizations, science, as it is organized and practiced today, is an important arm of the Establishment. In science, the culture is not yet free of the social form, making scientists the priesthood of high civilizations. Not only do scientists have and organize more knowledge, they have established canons for truth and are even beginning to examine those contexts in which the canons of science do not apply.

What started out merely as an arrangement of the observations of early farmers, whose very food depended on integrating their subsistence activities with the seasons, has become so organized and socialized as itself to present a basic threat: it has a way of reducing all other modes of experiencing or organizing the human situation to "nonscience," which can be too easily equated with nonsense. To be against science because science, as a mode of knowing, has put us all in a straitjacket is difficult without appearing to be a know-nothing. People who question science's right to its unique position of power have an Anti-Vivisection League air about them. Yet we know that science may not be a very good basis for making social decisions. The task is, of course, to correlate science with ethics—a factor that has loomed ever larger since the Manhattan Project, when it first became evident to all that the question is inescapable.

Science cannot solve ethical problems. But scientists cannot free themselves from them. Social science cannot solve ethical problems either, although this is the role in which most "hard" scientists (in their own powerlessness) seek to cast it. And the reason that this is so, and will remain so, is that the canons of proof for solutions to ethical problems are once for all different from those that science inveighs.

Poverty. We have seen that at the time of the so-called agricultural revolution, security was reduced the very while the carrying capacity of the land and the society was increased. Thus, the pressure of overpopulation in a hunting territory was, by a cultural solution, turned into the pressures of insecurity of small farming communities. Then, through the years and centuries, distribution facilities were improved and new ways of food storage invented. Although, apparently because of prejudice and fear, we do not use the most effective method we have for storing food (a radiation process), food storage as a purely technical matter is not the point of greatest difficulty today. Technical problems remain, but the Western world is good at solving technical problems.

However, advances in food production and food storage do not extend to food distribution because food distribution is done through the medium of money, and in the program of money you still have to program social status. That is, in our scheme for food distribution, we program a number of factors other than the amount of food and the amount of hunger. It is akin to the need in the Japanese language to program in verb endings the status rank of the addressee. In today's world, these extraneous factors in monetary programming have to do with status and rank.

Whereas famine is the scourge of a peasantry, chronic malnutrition is the scourge of the civilized poor. Famine is caused by crop failures and lack of a long-distance distribution system. Chronic malnutrition may occur anywhere, caused by lack of protein or certain vitamins in the diet available to any people, but it is certainly rampant in situations where poor and hungry people must choose between spending scarce money for "good" food or for other things that they feel they need as badly. Poverty does not merely cause malnutrition—it positively encourages it.

Specialization of Tasks. Scholars of the early- and middle-nineteenth century saw that hyperspecialization within the system of factory industrialism led to a situation among the people (Marx called them workers) that we today call "alienation." They also saw that all of us are workers, becoming increasingly more specialized. Adam Smith's vivid description of specialization within the pin industry stands as the first horror story (although he did not mean it to be) of industrialization. Robert Owen, among many others, tried to create social systems that would take advantage of the new technology without paying the price of alienation. When the individual must perform a task too far removed from the other tasks necessary to make a final product, and when he is also out of touch with the user of his product, the stage is set for a process of alienation. When the number of people with whom each of us interacts becomes sufficiently large, we must also specialize our kinds of behavior in interaction. Obviously, all people (all animals) socialize for specific interactions, but in civilizations, there must be an active buffer (such as the Chinese family) or this specialization proceeds to the point where each of us performs only a few types of behavior with each individual we know. Our personalities segment with increased social complexity. Nobody knows "the real me" because the amount of me that I expose to any one person becomes a lesser proportion of all of me. Intimacy thus becomes the victim of large-scale industrialized societies.

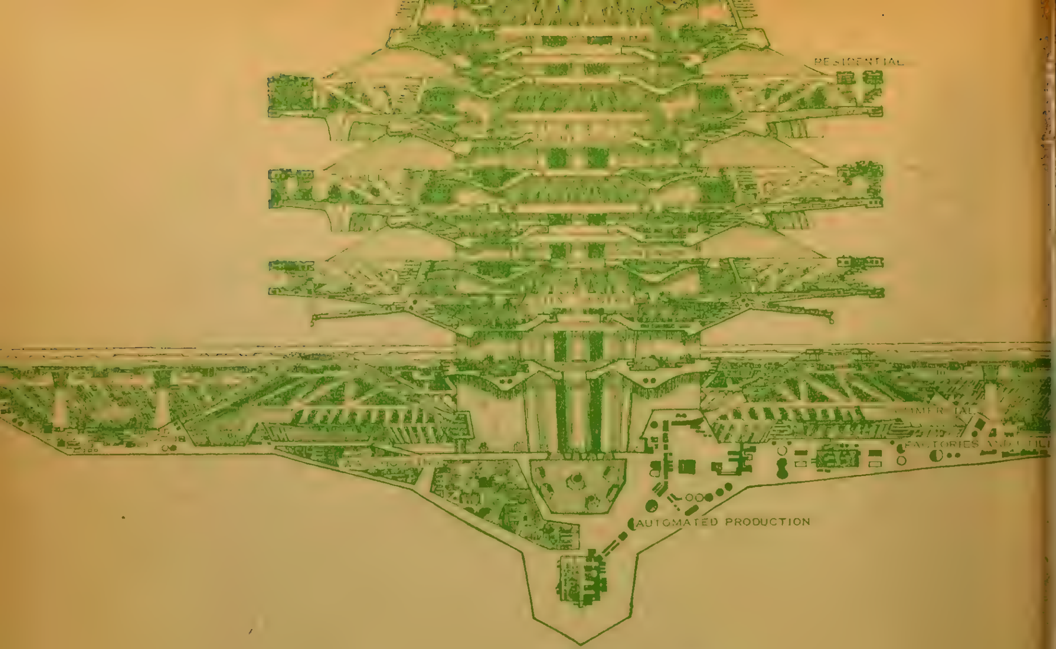
Simmel, the great German sociologist of the early twentieth century, explained that progressive social differentiation must be overcome by constantly stronger and more effective social organization. But there is another dimension that Simmel did not note: When alienation proceeds to a certain point, human beings develop insight. They learn to apply ethical judgments (good and bad—for one's self) not just to each other but to the very organization itself. And the organization is so large and so gross a mechanism that presently they can exist in crannies of an organization in which they scarcely participate. If, in a state of alienation, organization is associated with "The Organization" and rejected, then still a new dimension is apparent; like rogue elephants, we can opt out of "the society."

This specialization of tasks also vastly increases the number of choices each individual citizen must make. Each must now decide *what* he is going to specialize in: "What are you going to be?" And the protesters loudly protest with a basic truth, which annoys and frightens those who have already made a choice: "I am going to be a man." It is the cry for integration.

It seems that a new kind of ethnicity is developing to take care of these needs: all kinds of social groups, comparable to ethnic groups in their cultural discreteness and interpersonal trust and warmth, are emerging. The search is for a small, intimate community of people who "care," so that fractionalization and specialization will be held at bay within at least some social corners. The goal is comforting, shared culture.

Government, Bureaucracy, and Tyranny. Hunting and gathering bands usually answer the questions of law and military protection without formal organization; if there is formal organization, it is almost always based on kinship. But with the agricultural revolution, and doubtless in some places before it, the size of the population became such that kinship no longer worked as the basis for control, organization, and use of power. The state is an emergent sort of organization based on citizenship and contract (for all that the "social contract" of the eighteenth century was erroneously written as mythical history, much of what was said was correct if we understand it as an evolving organizational principle). If contracts are to be successful, there must be far more explicit sanctions than those provided by a kinship system. Indeed, successful contract law usually involves a police force, which assumes—which *is*—the state organization. The problem then becomes a matter of perfecting the organs of the state. The system that always seems to have been adopted is the bureaucracy.

Bureaucracy makes governments (as well as large firms for production and distribution of goods) work. The rules in a bureaucracy become rules independent of specific situations or contexts. The bureaucracy thus becomes, at



a social level of culture, divorced from any specific, thinking, creative mind. When that happens, two opposite but equally horrendous things occur: most people who are regulated by the system are cut off from any single source of power sufficient to alter the system, while a few can capture the bureaucracy and turn it to individual ends. Any bureaucracy that does not have a built-in system for making exceptions dies of its own machinations; but any bureaucracy that does not have a built-in device for dealing with tyrants is ultimately overthrown. Bureaucracy becomes "inhuman" because it is culture, in the form of rules, that is independent of situation or even of need.

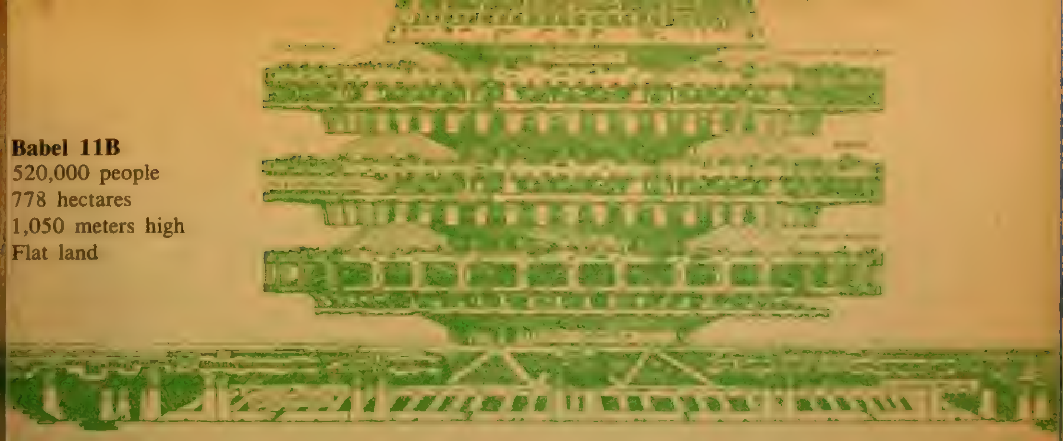
Thus, as an integral part of the social form of the state, a new form of tyranny was introduced into the world. In well-run, orderly states—just as in the stateless societies that preceded them—people are not controlled by force, but rather by unwritten, invisible codes of ethics. The sanctions are there, but on most people they need never be brought to bear. With size and bureaucracy, however, and especially with poverty and that set of urban conditions that has become known as the "cultural sink," ethics disappear—and "naked power," as it is often called, takes its place. Violence is the simplest form of social interaction in any context because it takes the least amount of commonly understood culture to make it go.

Like everything else that is successful culture, the state grows, and with growth, its nature changes. The state becomes immense; the bureaucracy and danger of tyranny are also immense. Immense and expensive. Goodwill—good behavior—is the cheapest sanction; policemen are less efficient and much more expensive. When the alienated individual cannot "identify" with his state, the expensive police become more expensive. Tyranny increases. The state becomes separable from "the people" and begins to treat them as an audience. And every show has a Nielsen rating.

Status. Bureaucracies, by existing, affect the stratification of society, setting a new tone for stratification by privilege. The basis for ranking culture (and therefore people) changes. Privilege may be marked by scarce commodities or by some concept as difficult and pervasive as race. The moment that a bureaucracy, or any hierarchy, becomes a prison, rather than a device for creating stability and predictability, society is in trouble. And societies in trouble always seek ways out—and everything changes again.

Excluding people from culture that they want and can handle has never worked, and it shows no sign of working now. Yet it is a

Babel 11B
520,000 people
778 hectares
1,050 meters high
Flat land



favorite human form for expressing and maintaining dominance patterns. All stability is tied up with dominance systems, but with human beings a dominance system inescapably carries a moral dimension. The morality of power. Today, instead of "Who dominates whom?" young people ask, "What right has the Military-Industrial Complex of the Establishment to run our lives?" To the question, "What do we do with waste products?" they add a little relevance-context to the specific problems of our specific age: "What right have profit-making producers to foul our waters and our air?" I have, here, done no more than ask the same questions in two sets of language.

Garbage and Urban Blight. Life is a complex chemical process for turning food into waste. Isak Dinesen, that magnificent Danish writer of English, whose real name was the Baroness Karen Blixen, put it delicately: the human body is a complex and "ingenious machine for turning, with infinite artfulness, the red wine of Shiraz into urine." What one might call the inverse Midas syndrome.

Ecologists and space scientists have taught us, in the last few years, to look at this problem in terms of the recycling of chemical elements and the influence of social systems and culture on that recycling. In space travel the environment goes with us and is so circumscribed that the cycle has to be a very short one so that compactness can be achieved. That is to say, the devices for turning carbon dioxide back into carbon and oxygen have to be extremely efficient and the squeamishness of space travelers must go by the board. In short, waste products must be immediately returned to food. The "balance of nature" is, of course, the same process stretched out in time and rendered invisible. In a balanced ecology, the recycling of all chemicals is in moving equilibrium. What is waste to one organism is food to another. The result is no large-scale change because of constant, small-scale changes.

However, for centuries in all civilizations, and particularly in Western civilization, there has been a disregard for the degree to which human beings are involved in recycling—a part of the same syndrome that until very recently made it so difficult to admit that human beings are animals. "But not *just* an animal," they insist. Of course not, but neither is a muskrat "just" an animal. Every kind of animal is a special kind of animal. And once the admission comes, there is a typical overreaction on the part of the many—they leave out the characteristics the "not *just*" was meant to cover, and human beings are called naked apes.

Today we have to face the fact that all culture, in a very real and immediate sense, is the waste material created by human life. Human living makes culture. The question, therefore, has to be: What out there in the environment turns culture back into food? Culture obviously changes nature's recycling balance.

All human habitations have midden heaps surrounding them; archeologists would soon be out of business if this were not so. Mounds of clam and oyster shells surround early Scandinavian settlements; mounds of garbage surround New York City. We are still making midden heaps, assuming that nature will recycle our waste. But we see now that the question is becoming urgent. How do you recycle plastic? We are now using garbage as fill. As soon as we learn to "stabilize" it we can build mountain chains. After that, the next step will be to put landscape architects to work on it.

All this is only the most obvious manifestation of a greater truth: urban agglomeration, with sufficient size, becomes the cultural sink. The very concentration of people that is required to have a civilization has been so treated by civilization that civilization is not possible. Irony, like garbage, is all around us.

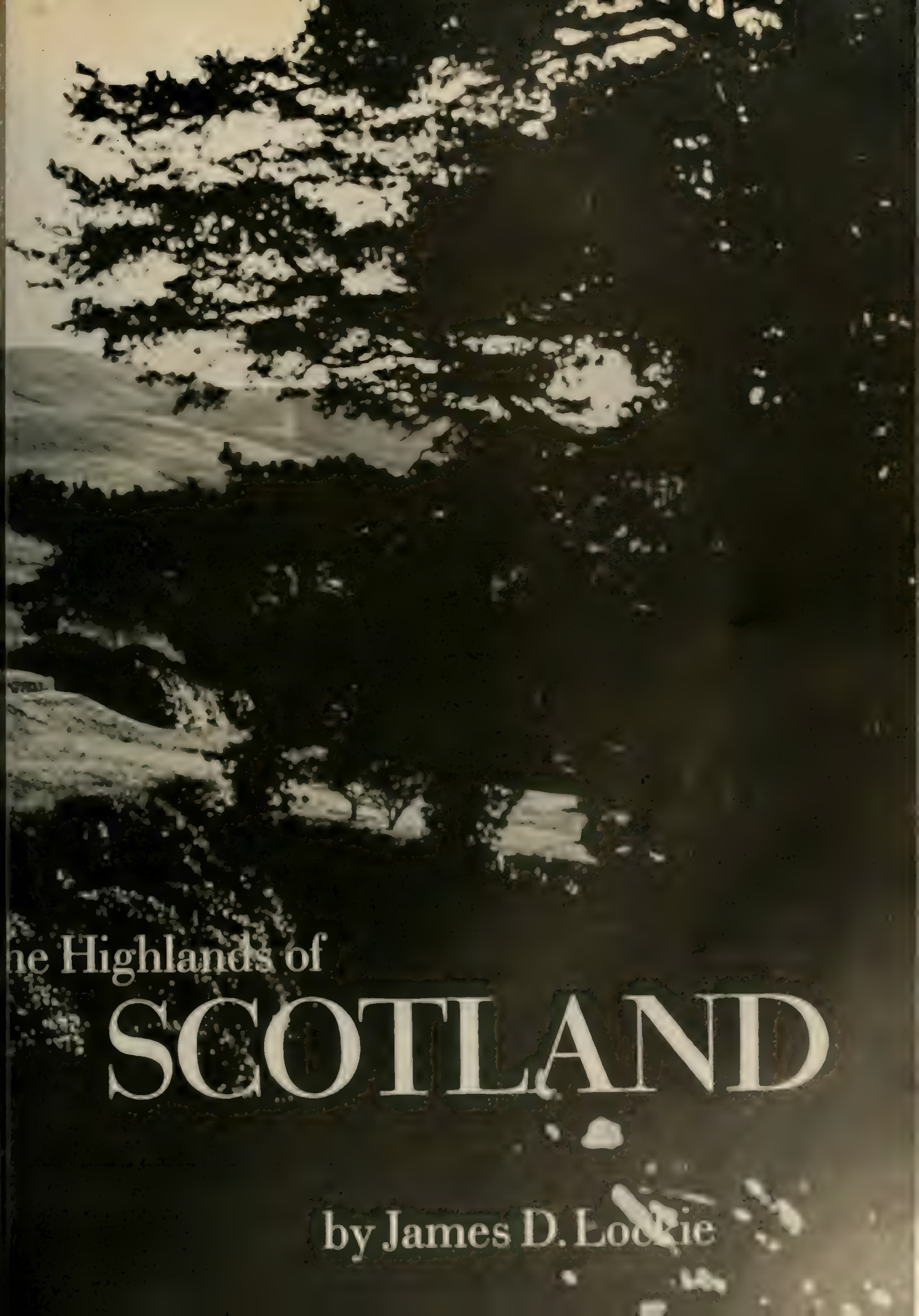
Population Control and Room to Live. Like precivilization on the eve of civilization, we have a vast overpopulation problem, and our resources are running out. In those days it was the large mammals that could no longer live in a situation dominated by so many human beings. In addition to instituting population control policies (most primitive societies, before contact, had workable population control policies), human beings also invented new culture by means of which new resources were utilized. And the population again exploded.

Toward Postcivilization

It is hard to see, just now, whether the present situation is a repetition of the pressures that gave us civilization or whether we are actually pressing the carrying capacity of the world. Certainly, we cannot count infinitely on cultural ingenuity to get us out of our difficulties. We must recognize that hereditarily human beings are programmed to multiply at a rapid rate and that, ironically, culture has now changed the "demand" for human beings. Cultural pressures must indeed be brought to bear to alter the very "instincts" of the animal. The last decade has seen a home truth—that voluntary family planning will not solve a population crisis, for all that it may lessen human suffering. We are also beginning to learn about the response of the body to spacing and to crowded conditions. Again, we must either alter the environment or "evolve" (with or without the help of drugs) means for altering our very metabolisms.

In talking about social change in the basic fabric of civilization, it is difficult not to become a Cassandra. Cassandra, poor dear, was merely an intelligent girl with a capacity for questioning the basics, for seeing beyond the immediate to the fundamental questions. Anything she said about those fundamental questions either had to be disbelieved or else overstated in such a way that only discomfort for her hearers could result. When one is trying to analyze the changes that have been made at a fundamental level but have not yet fully come to cultural expressión, one is likely to be read as a presager of doom.

Yet, change is not doom—it is the very antithesis of doom. Doom is to be found in the struggle to resist change—salvation comes with understanding it. We must, to survive, see our emergence into Phase II civilization as a new opportunity to understand the mysteries of life, culture, and whatever emerges next.



he Highlands of
SCOTLAND

by James D. Lockie

For centuries, the heavy hand of man has snarled the fragile webs of life in the forests, moors, and heathered slopes of Scotland

They say in Scotland that "guid gear goes into small bulk"; and most Scots would apply this to their country, for Scotland is small but varied.

It has the oldest and youngest, the richest and poorest rocks; it has a dry east coast and a rain-sodden west with peat bogs; it has cool areas and warm areas where subtropical palms grow well; it has large inland waters like Loch Ness and a west coast with sea arms that cut 20 miles into the mainland; and from rocky or sandy shore to arctic alpine mountaintops may be only a few miles. All this in a country 200 miles by 80 miles.

Scotland has had human occupation from earliest times. Its rich fauna included wolves, brown bears, lynx, and white-tailed eagle, all now extinct. The landscape we have now, and the wildlife that inhabits it, can only be understood by reference to the social, political, and economic factors that have interacted and still interact with the physical environment.

About 3000 B.C., Scotland was heavily forested. From the beginnings of agriculture, areas of forest were cleared first by burning, then by cutting; and the clearance intensified under settled agriculture and pastoralism. In the centuries that followed, Anglo-Saxons, Romans, and Scots from Ireland continued to clear more forest, and further tracts were destroyed during Viking and clan raids.

The seventeenth century saw the start of forest clearance for commercial purposes when the oak and pine forests of Highland Scotland were used for iron smelting and boat building. After the crushing of the 1745 uprising, a form of feudalism replaced the clan system in Highland Scotland and exploitation of the land's resources was greatly accelerated. Sheep graziers fr the south moved north to occı much of the Highlands, and tl continued the destruction of foı by felling, burning, and bark trees, and by preventing most t regeneration. The ending of c warfare, followed by the introd tion of the potato as a staple fo led to a population explosion in Highlands. The landlords used t population boom as an excuse clear whole districts of their hun inhabitants, replacing people w flocks of Blackface and Chev sheep.

The dispossessed drifted south the developing industrial ar emigrated to the United Sta Canada, and Australia, or accep the tiny inhospitable holdings, crofts, offered to them along the lantic coast in northwest Scotl where they eked out a living fishing and subsistence agricult

The nineteenth century also the development of grouse m and deer forest. The first is an a managed to control the heat plant and encourage large numb of the red grouse that depend on the deer forest is an open area ten without trees) of moor, h and mountain on which the Scot red deer live. The hunting of th creatures soon became fashion among the new class of wealthy dustrialists that was forming in south. Thus, while a reduction human population is often rec mended as a prerequisite for proved land use, the savage depo lation of Highland Scotland me began an era of intensified ploitation and often extensive use by overgrazing, burning, the destruction of wildlife.

In this century, two new form land use have taken their place side hill sheep farming, croft and sporting: commercial tin farming by the state and by private landowners, and nature conservation by the state and other public bodies. Added to these are hydroelectric schemes and a rapidly growing tourist industry.

All this has had, and continues to have, a profound effect on wildlife. Since the balance between these various uses of the land is not yet resolved, we can expect further changes in the future. We can see more clearly the nature of these changes by considering four importe ant animals in Highland Scotland —the golden eagle, the red deer, the red grouse, and the red fox—and the effect of land use upon them.

The golden eagle is protected by aw and violators face heavy fines. However, it is often illegally killed n remote hill country. Since few ature reserves can wholly maintain pair of eagles, which need a teritory of from 5,000 to 20,000 acres, the future of golden eagles lies largely outside nature reserves.

The danger to this species stems from the complaint that it kills lambs and red grouse. Eagles in the eastern Highlands, where wild prey are plentiful, rarely eat lambs. But in the west, where wild prey are generally scarce, they do so regularly. Indeed, there are few pairs of eagles in the west that have not at some time brought lambs to the eyrie. The inference is that lambs are not preferred prey. This is supported by the fact that in the western Highlands eagles that do not bring lambs to the nest always have some suitable and locally abundant prey such as rabbit or hare.

The eating of lamb does not necessarily mean that the eagles kill the lambs. If an eagle kills it, the lamb shows a large area of bruised blood under the skin of the nape and rump; if not, it shows only talon marks and no blood. If the eyes are out, a crow has been at the lamb first. If the ears and tail are chopped off, a fox has been there first.

Proceeding in this way I estimated that one pair of eagles killed only one-third of the lambs they brought to the eyrie; the remainder they picked up dead.

The winter food of eagles comprises a great deal of sheep and deer carrion. Estimates of the amount of suitable live wild prey on these western mountains, by ecologists Leslie Brown and Adam Watson, show that there is insufficient to keep a pair of eagles going for many years. They therefore seem to depend on carrion.

Why are wild prey scarce and why are there dead lambs and dead sheep and deer in the Highlands in such plenty? The reasons are various. Red deer, until recently, were undercropped; therefore they overpopulated the hills and many died each winter. Sheep, too, are often overstocked. To compensate for increases in their pay, each shepherd must look after more sheep, which he therefore does less well, particularly in the rugged terrain. Prolonged heavy grazing has so damaged the quality of many hill grazings that the sheep crop has become increasingly unprofitable. Lastly, the use of uncontrolled fire has accelerated erosion and changed the vegetation to unpalatable fire-resistant species. All this misuse of the landscape has made the typical wildlife prey, such as grouse and hare, much scarcer.

It is paradoxical that the sheep industry, which complains of eagles as pests, is the very one that has not only reduced the eagles' wild prey but also perpetuated high numbers of eagles by deaths from its own flocks.

The Highlands of Scotland
Outer Hebrides
NORTH WEST HIGHLANDS
Inverness
GRAMPIAN MOUNTAINS
Glasgow
Edinburgh
0
50
Miles

In the early 1960's the hard pesticide Dieldrin, used in sheep dips against ectoparasites, further reduced the breeding success of eagles and other raptors that fed on mutton flesh and fat. But Dieldrin has been withdrawn from use and the breeding of eagles is now back to normal.

In the eastern Highlands, the golden eagles are closely linked to grouse moor management. They are often shot or trapped because they eat grouse or scare them from the moor when shooting is in progress. If an eagle flies over a moor ahead of a hunting party, the grouse will fly away, thereby ruining the hunt.

The Nature Conservancy Unit of Grouse and Moorland Ecology has demonstrated for grouse the truth of Paul Errington's contention that superfluous birds are most vulnerable to predation. Since these grouse are surplus to the carrying capacity of the heather habitat, their loss does not affect the stable grouse population. Since they have no territory, these grouse cannot breed and are doomed to die from starvation, disease, predation, or accidents. This research demonstrates that the continuing war against bird predators is stupid since it serves no purpose in conserving the stocks of grouse.

Much of what has been said about the eagle applies also to the fox. Here, lamb killing is the main problem. The fox undoubtedly takes lambs at times and anyone might agree that this is reason enough for the almost hysterical annual onslaught on foxes with guns, traps, poison, snares, and dogs. But the ecologist would want a little more information before passing judgment.

The fox is also a scavenger, an eater of lamb and sheep carrion. The question to which there is no answer yet is: what proportion of lambs picked up by foxes are already dead? The ecologist would also want to know what foxes normally eat, since they cannot live on lambs throughout the year. In the Scottish Highlands the fox's food includes red grouse, hares, rabbits, deer calves, lambs, deer and mutton carrion, and large numbers of short-tailed voles. Voles are wholly vegetarian and feed on the best grasses. They eat twice their weight, about two ounces, in green grass each day; in a countryside short of nutritious grass in the winter, they may compete with sheep and deer.

Field voles are also hosts for the early stages of the tick that transmits a virus disease of hill sheep called "louping ill." The disease is a major veterinary problem on many hill sheep farms. When their population density is high the voles and other small mammals can be important as amplifiers of infection, for more juvenile ticks can feed and survive. In addition, a proportion of ticks become carriers of the virus; together, these increase the risk of infection of sheep in subsequent years. A similar situation has been described in Czechoslovakia where after "mouse" or "vole years" there are outbreaks of tick-borne encephalitis in human beings.

Because foxes, above, kill thousands of voles, they may help sheep. Golden eagles, right, take many hares, which compete with sheep for browse. Yet herders condemn both eagles and foxes because they occasionally kill lambs.

Gamekeepers lead deer stalkers, mainly upper-class landowners, to herds of red deer. Then the stalkers creep across the rocky landscape toward the deer. By shooting only trophy-sized male specimens and by maintaining excessively large herds in the fragile habitat, the estate owners have unwittingly caused damage to the land and starvation among the deer.

A strong and varied predator force, made up of weasels, long-tailed weasels, short-eared owls, and foxes, could flatten out the peaks of abundance of voles and might reduce the prevalence of louping ill. Likewise, any reduction in the number of voles in winter saves green grass for sheep and deer.

These relationships are real enough even if we do not know their relative importance. They are mentioned because the prevalent attitude that "the only good fox is a dead fox" hides aspects of fox ecology that may be of economic benefit to the very sheep farmers who complain most about foxes.

Lamb killing usually stops when the parent foxes are no longer under pressure to kill for their cubs. Therefore the most effective time to control foxes for sheep farming would be during those months that the foxes are feeding their cubs. But the war against adult foxes continues throughout the year when they do no harm to sheep. Why not, until we know more about the ecological role of the fox, leave the adults alone so they may kill voles for ten months of the year? Some measurements that W. N. Charles and I did of predation by weasels, owls, and foxes on voles in winter showed that the predator force alone reduced the voles from 90 per acre to 45 per acre.

The red grouse is a famous game bird indigenous to Scotland. Grouse shooting is a rich man's sport. The usual method of shooting is to build waist-high walls of turf or peat (called butts) at intervals across a hillside. The shooters stand behind these with a gun bearer who loads the shotguns quickly and passes them to the shooter. A line of beaters drives the grouse downwind over the shooters. Another method used where grouse are scarcer is to walk up individual birds with dogs.

In the original vegetation of the Scottish Highlands, red grouse were sparse, confined to the dwarf heather that grows between the treeline and the upper limits of heather and also to open areas in the forest. Deforestation presented the red grouse with new and extensive heather-dominated habitats at low elevations.

Management for grouse has consisted of a strange combination of good sense and crazy notions. The main activities for the past 100 years have been heather burning, predator control, and limited shooting to leave ample stock for breeding. Only recently, however, has the relative importance of these activities been clarified.

Research has shown that the shooting of grouse over butts has never overexploited the annual production of birds. After the shooting season, the grouse adjusted to the lower population and ejected, by territorial display, a surplus of birds.

This adjustment drove the surplus birds to marginal areas, such as the grassy edges of streams and areas of poor heather. In these poor habitats the losses of surplus grouse were higher than losses sustained by the resident territory holders. Many deaths were due to predation, but these surplus birds also were less well nourished and carried a heavy load of parasites. They were a doomed surplus, except for a few that replaced the occasional territory holder that died. Thus contrary to century-old notions in grouse management, predation during winter does not affect the stock of grouse surviving to breed in the next spring and the practice of saving birds for breeding has nothing to recommend it. The grouse decide for themselves.

The number and size of eggs, the hatching date, chick weights, and hatching and rearing success of grouse vary from year to year. All these factors tend to be larger in years of early nesting, leading to good breeding success. All are smaller in years when nesting is late. In years of good breeding, the adults survive well through the winter before the breeding season; in years of poor breeding they survive less well. Thus, the survival of chicks is conditioned by events affecting adults before the eggs are laid.

Food affects the condition of adult grouse and the quality of their eggs. The quality of heather (the staple food of grouse) is influenced mainly by its growth in the preceding summer. A significant
correlation exists between th
growth of heather in one year an
breeding success the following yea
In most years, breeding success de
pends on the bodily condition o
resident breeders just before th
eggs are laid.

Different moors have differen
average densities of grouse. Gene
ally, moors on good soil-formin
rocks always have good breedin
success and stable population
whereas moors on poor soil-formin
rocks have unstable population
Territorial behavior acts as a bu
fer between population size and th
heather food resource, workin
more strongly in good, rather tha
in poor, habitats.

The ability to maintain an ad
quate grouse population depends o
habitat management. This mean
heather management. Grouse hol
territories of from five to ten acre
Ideally, within this area ther
should be medium-aged heathe
which is nutritious and provid
shelter, and old heather, which pr
vides cover for molting and escap
from enemies, as well as areas fo
young heather to grow.

One means of achieving this i
terspersion of stages of heather
by fire. Without fire, the heathe
plant has a growth cycle of 15 to 4
years, after which trees invade an
forest succession proceeds.
burning heather, the succession i
put back to the earliest stage, an
by rotational burning the succe
sion is halted at heather moorland

From the grouse's point of vie
the ideal size of fire is about on
acre. Therefore on a 10,000-acr
grouse moor with a 10- to 12-yea
burning rotation, the ideal woul
be 1,000 one-acre fires each year
Because the law allows burnin
only between certain dates and be

Once heavily fore
with hardwoods, m
of the Highlands al
Loch Katrine are
treeless and suscept
to deep gully eros

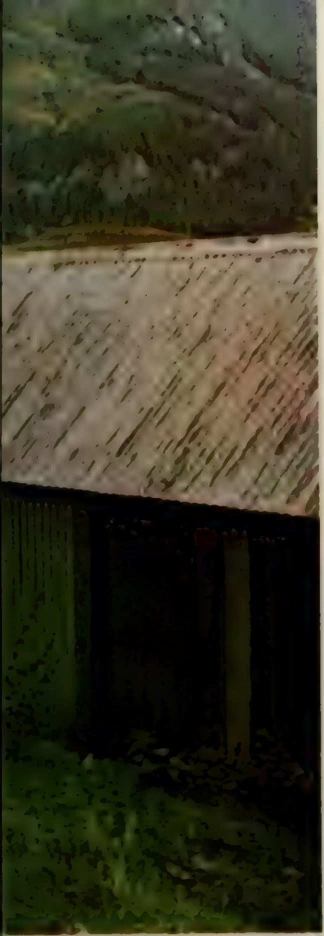
cause of a shortage of labor, this ideal is rarely achieved, although the best grouse moors come close to it.

The success of heather burning is most evident in the eastern Highlands of Scotland where the climate and topography make maintenance of the heather cover fairly easy. As one moves west, the climate becomes wetter, the slopes often steeper, and the underlying rocks poorer. Burning under these circumstances must be done with ecological good sense since, without it, heather can easily be replaced by grass and erosion accelerated.

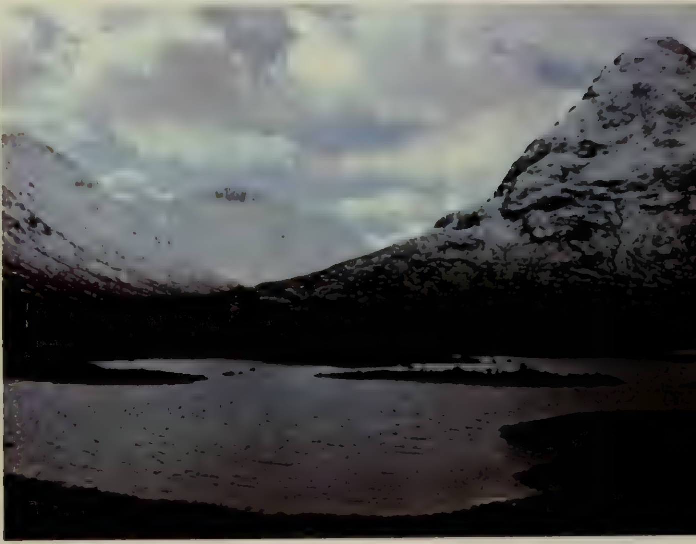
In the western Highlands burning as a management tool—first for grouse and then for sheep and deer—was taken from the east and applied without much thought. Out of this, a tradition of burning the heather each spring has developed. No attempt is made to control the fires and great areas are burned each year. Toward the end of April the whole landscape is blue shadowed with a pall of smoke that is almost continuous for 200 miles. The uncontrolled fire in the wet west changes the vegetation from a heather, sedge, and grass community to a sedge- and grass-dominant community. On steep slopes in a heavy rainfall, accelerated erosion often occurs. The combined effect has been to make the country less habitable for wildlife in general and grouse in particular. Despite the cries against hooded crows foxes or eagles, or the complain that the Forestry Commission harboring predators, it is man own activity in misusing fire th has caused the decline in grou in the western Highlands. As wi many wildlife—land use problem a solution lies in educating peopl but we have a long way to go.

The red deer in Highland Sco land are descendants of anima that once lived largely in forest, they still do on the continent of E rope. In Scotland, some have r turned to forest living now that e tensive forests have been planted b the Forestry Commission, althoug fencing generally keeps them ou

Continued on page



Farmers and herders living in ancient stone houses, left, still eke out a meager living from the land of Inverness-shire in northern Scotland.



Scenic vistas, above, and romantic castles, such as the island castle at Rannoch Moor, left, draw an increasing number of tourists to the Highlands.

The long-haired Highland cattle, following pages, thrive in the cold, wet environment of Scotland

Ancient stone markers covered with moss and lichens stand at the sites of famous battles between Scottish clans.

Thistle and o
browse-resis
plants domi
many area
the Highla
Herders often b
the moors i
attempt to ren
unwanted vegetat

After a heavy rain, water drains rapidly from the bare Highland slopes, creating many cascades such as the Falls of Folloch.

pon but not silenced, a
oup wails his complaint at
flattened by a two-ton
earing up in a vocal threat.

THE AGGRESSION OF THE BREEDING BULLS

When northern elephant seals haul out
on land to mate, the massive bulls begin
a fierce contest for females.
Island rookeries resound with their challenges,
and combat—often bloody—
finally establishes a social hierarchy

by Burney J. Le Boeuf

Few animals fight as fiercely and violently as bull elephant seals. The speed and power of their downward-slashing blows are so great that the blubbery exterior of the recipient undulates with the force of impact. Their bloody battles color the water for several yards around them. During the breeding season males bear an assortment of wounds and scars; some have punctured eyeballs, split proboscises, or chunks of skin and blubber torn from their backs. What is all this fighting about? Is it advantageous to the species? What are the social and genetic consequences of fighting in this animal?

Elephant seals are seen in the wild by relatively few people, since the northern species, which inhabits the coastal waters off California and Baja California, Mexico, is rare and its southern relative is circumpolar. The two species look alike except for their size and their most outstanding feature, the proboscis. The snout is larger and more pendulous in the northern seal; in its relaxed state it may hang almost a foot below the chin, giving the animal an elephantine appearance. When the seal vocalizes, its nose falls into its open mouth. Females and young males lack this elongate appendage.

The southern elephant seal, *Mirounga leonina,* is the largest of the pinnipeds, reaching 20 feet in length and weighing up to three tons. The northern species, *M. angustirostris,* is a bit smaller, averaging up to 16 feet in length and weighing about two tons. Females of both species are petite compared to the males, about 10 to 12 feet long and weighing a little less than a ton. A six-inch layer of blubber makes up about 40 percent of the animal's weight and insulates it against the cold waters it inhabits.

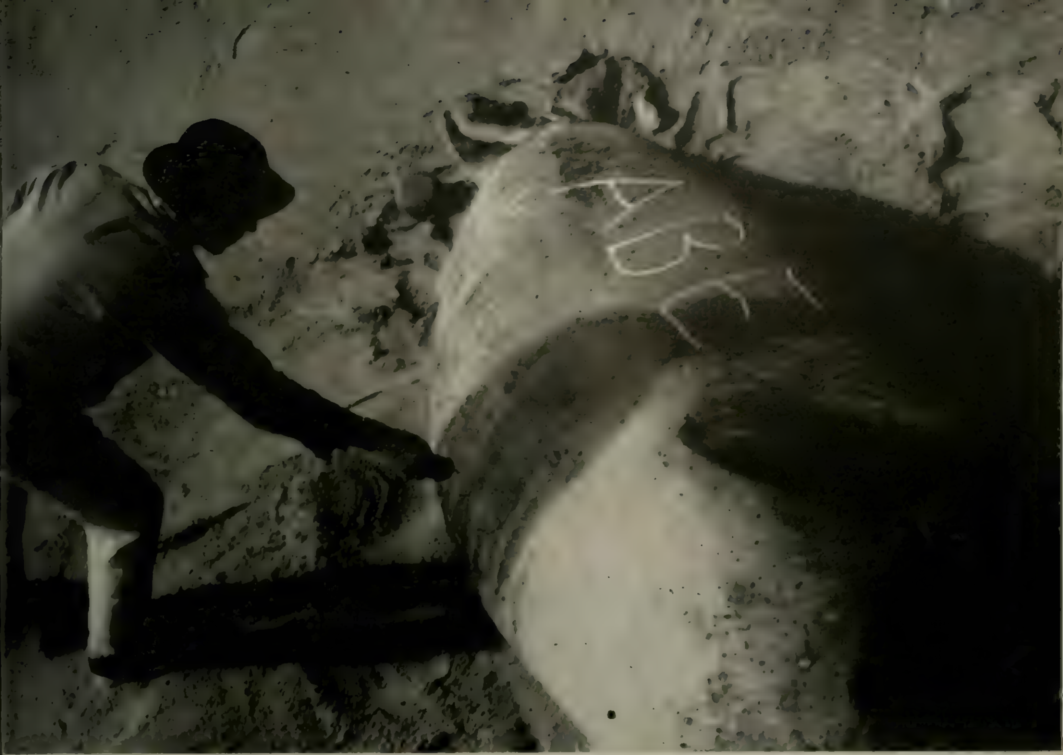
Large, viscid eyes and a thick shield of rugose tissue on the neck and chest, important in absorbing blows during fights, add to the elephant seal's reputation as a curious and peculiar animal. It elicits bizarre expressions and superlatives such as "grotesque sea cucumber," "the ugliest of animals," and "the world's most improbable animal."

Like most pinnipeds, elephant seals use the sea primarily as a source of food, but other important biological functions, giving birth, nursing the young, and mating, occur on land. Land areas used by seals are traditional. The animals return to the same location year after year, which makes them easy animals to study in their natural habitat. It has also made them easy prey for sealers.

During the last century, hundreds of thousands of elephant seals were killed for the oil that could be rendered from their ample layer of blubber. Gigged and prodded to the water's edge, the seals were shot and their fat flensed in the space of three to four minutes. The slaughter, indiscriminate of age group, was on such a grand scale that both species were nearly exterminated, and the animals soon ceased to be an important source of oil. It was not until 1910 that the southern elephant seal had recovered sufficiently to elicit further commercial exploitation, but this time licensing was introduced. Sealing
still permitted at the largest roo
eries, but the number and type
animal that can be caught is strict
controlled.

The northern elephant seal w
virtually extinct by 1869 and
longer a feasible business ent
prise. In 1890, the known pop
lation consisted of a single herd
fewer than 100 animals on the
mote island of Guadalupe, 1
miles off the coast of Mexico. T
small size of this herd, and its
accessible hauling grounds, made
unattractive to sealers. Even so t
remaining animals were sought

**The author drips blea
the pelage of a sleeping
which will keep its
identity until the next**



ectors for museum specimens. example, in 1907 Charles ler Harris reported what a won- ful sight it was to discover what thought was the last remaining l of elephant seals:

After viewing the herd to our sfaction, we took a number of tographs which are probably only photographs from life of elephant seal and which will the reader a good idea of these mammals. Two large bulls e then shot . . . ."

omehow, the number of animals dually increased. In 1922 when seals again attracted commercial attention, the Mexican government gave them complete protection. As the population increased, the breeding range gradually extended northward, reaching San Miguel Island during the late 1930's. In the 1940's four other rookeries were established: San Benito, Los Coronados, Santa Barbara, and San Nicolas. The most recently established rookery is Año Nuevo Island, 19 miles north of Santa Cruz, California.

The United States government has protected elephant seals since their re-establishment along the California coast. There are approximately 30,000 northern elephant seals in existence today, and their number is still growing—a remarkable comeback for an animal that was once called "one of the bygone wonders of the animal kingdom."

Northern elephant seals, which I began studying with the late Richard S. Peterson three years ago, "haul out" on land twice a year. One haul out is for reproductive activities and lasts from one to three months depending on sex; the other is for molting, an annual process in which the entire skin and fur are sloughed off and replaced anew. Molting takes about one month.

Bulls are extremely belligerent upon arrival at the rookeries in early December, the start of the breeding season. Most of their time is spent challenging, fighting, and chasing each other. The male that displaces another becomes dominant to him. The sum of these individual displacements results in a geographical spacing out of males on the beach, so that viewed from a distance the animals resemble magnets having a like charge: one repels the other and a safe distance between two individuals is always maintained. Aggressive encounters occur on the beach or in the water and continue until the end of the breeding season in mid-March. Breeding bulls do not eat during this period, even though some remain on land as long as 90 days.

By the time females begin to arrive in late December, the males

l harems, with pups and
congest a rookery
adalupe Island at the
of the breeding season.

have established a peck order, or social hierarchy. Unlike males, females seek out each other's company, and form pods, or harems, which increase in numbers and reach a peak of as many as 300 females during the last week in January. After this, harem size gradually declines until all females have left the rookery, usually by the second week in March.

A female gives birth to a single pup about seven days after coming ashore, and nurses it for the next twenty-seven days. Then, she weans her pup by simply leaving it and reentering the water. This is the end of the mother-pup relationship. However, the high fat content of the mother's milk has already caused the pup to triple its body weight, going from about 70 to 100 pounds at birth to 200 to 300 pounds four weeks later! The "weaner" lives on his blubbery fat store while making the transition from suckling milk to eating solid food.

Females come into heat about 24 days after parturition, and for up to a week copulation may take place several times a day and with more than one male. The receptive female is passive and does not initiate courtship; she demonstrates no preferences for certain males. In the space of 34 days or less, females give birth, nurse their young, and are reimpregnated. The fertilized ovum, however, does not immediately attach to the uterine wall and develop. There is a delay of four months before implantation occurs, and this period, plus an eight-month gestation period, insures that the female will give birth at the same time one year later.

The organization of elephant seal males with respect to females differs from that of fur seals and sea lions, which establish territories early in the season and fight to defend them. The aggressive encounters of fur seals and sea lions are specific to place, not to the individuals involved and females breed on territories with the territory holders.

Fighting in elephant seals is more widespread than in sea lions and may occur anywhere on
near the rookery. Instead of fi
ing for a place, fights are indi
ual contests over rank in the p
order. Status in this hierar
directly determines a male's r
tionship with females.

In all aggressive encounters
male tries to displace another eit
by threat or by overt attack. A
threatens his opponent by sim
staring at him, by facing him
lifting the head and neck, or
moving in his direction. The m
common threat behavior is a vo
challenge issued from a stereoty
posture. With forequarters elevat

A bull in repose: its long
hanging almost a foot b
the chin when relaxed, ea
the seal the name "eleph

ly molted "weaner" has
aced the black fur of its
ı with a silver coat
a thick layer of blubber.

mouth open and head thrown ck, a bull emits three to fifteen ıd, low-pitched pulsed sounds. If : threat is effective, the opponent nply moves a few yards away, ıs conceding his subordinance. If fails to move or does not move ıt enough, he is attacked and bit- ı. If the threatened male is domi- nt to the threatener, the former ves his own vocal reply and the tial threatener retreats. If the re- ionship is not established, both imals continue to vocalize as they ne together and fight.

Despite their unwieldy bulk and restrial sluggishness, these animals are remarkably quick and agile once poised and ready to fight. The stance is always the same. In a chest-to-chest confrontation, the fighters lift their heads as high as possible so that fully one-half the torso, about eight feet, is vertical. With their great heads cocked to one side, they rock back and forth, feinting and butting with the undersurface of the jaw and neck, jockeying for an open shot at each other's neck. The strike is powerful and fast, involving a downward-slashing blow with the wide-open mouth and ending in a ripping bite as the animal pulls away. Several blows may be exchanged before combat is terminated. The victor is not always the more aggressive animal, but rather the one who holds his ground; he may even receive all the punishment and not land a single blow.

Although the thick shield of cornified epithelial tissue on the undersurface and sides of the neck of mature bulls receives most of the blows, both fighters invariably suffer deep cuts and lacerations that bleed profusely. When a seal gets a bite on his opponent's nose, he holds on and jerks his head violently from side to side, worrying it in bulldog fashion. He may not release his grip until the nose is torn and shredded. The fight is over for this unfortunate male, and he beats a quick retreat as soon as he can. The nose can be a nuisance in another way. Usually the strike is delivered in such a way that the flaccid appendage swings out with centrifugal force and actually follows the teeth to the point of impact. Sometimes the timing is wrong and the end of the snout is in front of the bared upper canines as the blow lands. The animal bites his own nose!

Despite all the bloodshed, injuries heal quickly, even those that are remarkably severe. I know of no animal that died from wounds sustained in a fight.

Nine out of ten fights take place on land and last less than a minute. The great fights for high positions

last longer, particularly if one animal is pushed back and the fight continues in the water. Fights in the water last as long as 45 minutes.

Appeasement gestures adopted by the loser to signal defeat and turn off further aggression are common in most animals. But this behavior is either absent or ineffective in elephant seals, and the losing fighter is usually given a savage bite on the back or hind flippers as, giving up, he turns to flee. Even incipient attack is not always signaled in advance. Males that have just lost a fight, or that have retreated from a confrontation with a near-equal, often sneak up from the rear and bite an unsuspecting subordinate.

Fighting determines the ensuing relationship between two animals. In subsequent encounters the winner need only threaten the loser to displace him, thereby making his point with less energy expended. Threats outnumber fights by about sixty to one.

For a study area, Peterson and I selected Año Nuevo Island, a unique refuge for four different species of pinnipeds, 19 miles north of Santa Cruz, California. The study conditions were ideal. The colony was small, containing approximately 300 females and 100 males. Blinds overlooking key beaches were built before the animals arrived. Proximity to civilization enabled us to work in shifts and thus observe the animals continuously during each day of the breeding season.

The first major problem we faced was one that has plagued many field investigators of animal behavior. To fully understand the social behavior of an animal, you must recognize individuals from day to day, and if possible, from year to year. If your subjects all look alike you have to mark them. This task appears deceptively simple but is difficult at best. Usually it is expensive, dangerous, time consuming, disruptive, and with some animals, impossible. The elephant seal was a notable exception, but we didn't know this when we started.

There were conflicting rep
about the approachability of bu
While the old sealing books s
that males were indifferent to m
they indicated in no uncert
terms that bulls were danger
and would attack: "Always wa
you got a clear getaway when tl
comes for you like that. .
They'd kill you easy if they wa
so damn clumsy." It was a p
lished fact that George Barth
mew, a zoologist at UCLA, had
tained rectal temperatures fr
sleeping bulls, and there was a
mor that he had even sat on th
backs. But we rejected this
story as apocryphal when we s
our first bull haul out at the beg
ning of the breeding season.

We waited until one of them v
between fights and in a deep sl
before attempting our first ma
The idea was to get an aniline
mark on the animal—any kind
mark, at this point we weren't p
ticular. We emptied a fire
tinguisher, filled it with the bl
liquid, pumped up the pressu

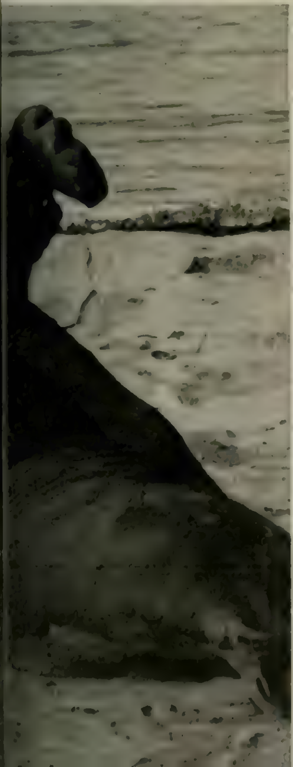
Peterson, having lost the toss,
ed out to meet "Macho," while
tched from the security of the
l. The bull woke up as soon as
first drops of dye squirted on
ack. In an instant, the massive
jerked up and the huge hulk
eled to face the man. Peterson's
onse was equally fast; he got
hell out of there. It was the
squirting out with too much
that woke the bull, but with-
the pressure we would have to
ven closer to the animal, so we
doned the fire extinguisher.

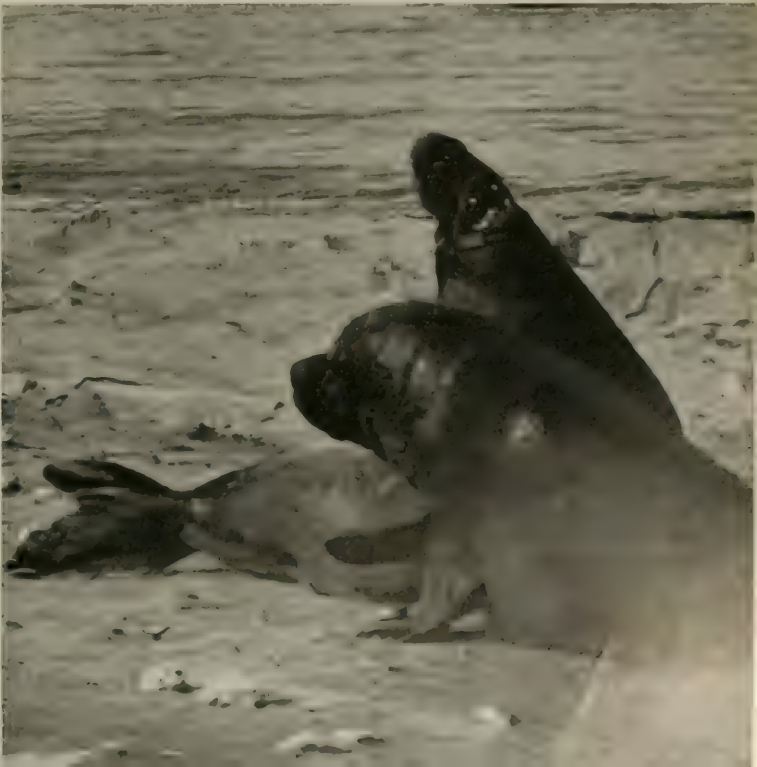
ark No. 2 was simple and effec-
Take a plastic sandwich bag,
t with marine paint (bright col-
are best), seal the top with a
er band, sneak up to the sleep-
bull, and let him have it. The
tity of the animal is then de-
ed by the location and color of
splotch, for example, CLS =
son left side, YLN = yellow
neck. The marks were easy to
nd lasted almost the entire sea-
but with 100 animals to iden-
you run out of combinations,
and it begins to get confusing. Besides, the technique was sloppy and esthetically offensive. By this time, we had learned it was possible to approach within four yards of a bull if he was lying down, leaving us running room in case he made a quick move. A paint roller on a long pole proved useful for putting temporary marks on animals even when they were awake and uncooperative.

The current technique is probably the final solution. In a plastic squeeze bottle, we mix 35 percent hydrogen peroxide with "Lady Clairol Ultra Blue," a commercial emulsifier, shake the bottle, sneak up to the sleeping seal, and write a name on its back in one-foot-high block letters. The pelage is bleached in a few minutes and the name, readable more than 100 feet away, lasts until the animal molts six months later. Long-lasting metal or plastic tags are attached to the hind flippers to facilitate recognition and re-marking from one breeding season to the next. With each male wearing the equivalent of a football jersey we were in a position to understand the game.

The form of the social hierarchy became clear soon after we identified the bulls and started recording all aggressive encounters, noting in particular who was displaced, where, and by whom. The hierarchy among males is remarkably similar to the peck order one finds among barnyard fowl. Within a single harem, the direction of domi-

Poised and ready to fight, the bull seal in background, left, rocks back and forth on his belly, looking for an opening. But foreground bull strikes first, center. He follows through with a tearing bite, as the loser begins his retreat, below.





nance is essentially linear. The top bull, alias the "beachmaster" or "alpha" male, displaces all other bulls in the vicinity of the females. If there is only one group of females, he is the lord of the entire beach. The second-ranking bull displaces all males except the alpha bull, and so it goes, except for certain deviations from linearity that sometimes complicate this simple structure.

Among seals a definite relationship exists between all males, certainly all high-ranking adults; one male in a pair dominates the other or is dominated by him. This is unlike the situation in the hierarchies of chickens and a few other animals where "no contest" relationships may occur between individuals.

Whereas high-ranking roosters have first access to food, females, and roosting and bathing areas, the only immediate advantage to high rank in seals is access to females. Females are the focus of male activity once they arrive at the rookeries. The higher a male's rank, the easier it is for him to get close to females. A male's place at any given time is a function of being pulled by his attraction to females and pushed away by his fear of other males.

The alpha bull locates in or near the group of females. Males with social ranks immediately below him (ranks 2 to 6, for example) are found along the periphery of the female group. Since each male attempts to keep those below him away from females, infiltration becomes increasingly difficult with decreasing rank. Each male is most occupied with displacing males immediately below him in rank, so that resulting fights are usually between individuals of nearly equal size, ability, and rank.

When the harem contains approximately 40 females or less, the alpha bull can successfully keep all other males out. As the number of females increases, the second- and third-ranking males may occupy a peripheral position in the harem. Although the top bull can displace them at will, the distance is too great and the task too much for him. As soon as he chases No. 2 away from the south section, No. 3 enters from the north. If action is taken against No. 3, No. 2 re-enters. With a harem size of 300 females, six to seven males can enter the harem periodically, but the situation is very fluid.

The first to arrive on the rookery in December are mature bulls, usually those that dominated the hierarchy in the previous year. They quickly set up a new social order. Males arriving later are at a disadvantage since they must fight for a place in the pre-existing order. The frequency and intensity of fighting increases during the second week of January, when arriving females begin to form in definite pods, and continues at a high level through February when the majority of females are in estrus. In early January, the alpha bull faces his more serious challenges, and he may have several bloody fights in just a few days. He is often challenged immediately after winning a prolonged, bloody fight, a time when he is tired and vulnerable. If he arrived early in December, he has already lost several hundred pounds and is showing signs of exhaustion. A defeat sends him crashing down several ranks, not just to the second position. If the alpha bull successfully defends his position during this period he usually retains the alpha position for the entire breeding season.

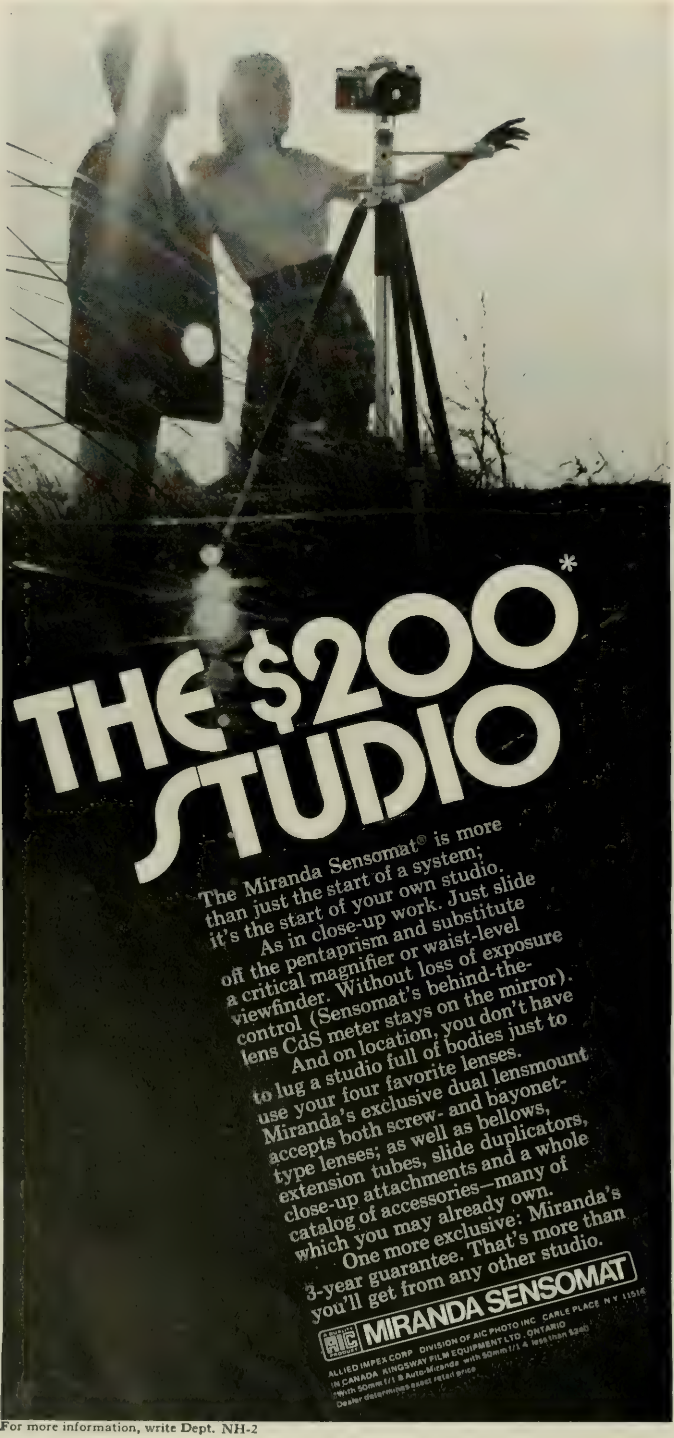
Good fighting is rewarded. Since females come into heat in the harems, only the few highest-ranking males have access to females and do most of the breeding. There were 115 males and approximately 225 females in two harems at Año Nuevo Island during the 1968 breeding season. Five bulls, or 4 percent of the males, engaged in 85 percent of the copulations observed throughout the entire season, and probably sired most of the offspring of the following year.

Social rank was highly correlated with breeding success. In the larg harem at Año Nuevo, the higher male's rank the more frequently h copulated. The alpha bull alway accounted for the greatest propo tion of matings, about 30 to 40 pe cent of the total in the three year observed. In the small harem, th alpha bull alone did virtually all o the breeding: 73 percent in 196 and 100 percent in 1969 and 1970 This discrepancy in performanc between the alpha bulls on the tw beaches was due principally to di ferences in harem location. Th large harem was located in the ce ter of a sandy beach on a point an males could approach from a sides. The small harem, situated o a narrow beach in a small cove c the opposite side of the island, wa surrounded by steep banks that r stricted intruding males to enterin from the sea.

As shown in several ways, the a sociation between sex and violen is close in elephant seals. Bulls hav a propensity for mating shortly a ter winning a fight. They do n court the female; they subdue he If a female is unreceptive to a bull direct approach, he overpowers h by biting the back of her neck by dropping the full weight of h head and neck on her body an pinning her down. Most aggressi activity, however, centers arou the majority of males that do n mate. Their failure is not due lack of sexual libido. Even t young pubescent males on t rookery, approximately five yea of age, dart in and mount femal on the edge of the harem, but th rarely get further than that. Pr vention of copulation before it o curs is the rule. Freedom to ma without interference is the sole pr rogative of the beachmaster.

For other males, interruptions

Even deep wounds
powerful blows heal qu
In three years of observ
no animals died from a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sult from threats or attack
higher-ranking males; the l
their rank, the higher the prob
ity that they will be disturbed.
desire to prevent others from c
lating is so great in some males
they will terminate their own c
lations to chase a lower-ran
male from a female. Those ca
flagrante delicto are bitten on
back. This matter of interru
matings is one of the most ob
differences between the social
tems of elephant seals and te
rial pinnipeds. Steller sea lion
northern fur seal matings are r
interrupted. No doubt, this is
ciated with the fact that femal
those species copulate but once
female elephant seal copulates
eral times a day for several
and sometimes with several d
ent males. Since many of these
ulations are incomplete, fe
promiscuity is probably a s
measure insuring pregnancy.

A female is still in estrus
she leaves the harem and go
sea. To reach open waters she
swim a gauntlet of peripheral r
in the shallow water offshore
the beach near the water's
These males wait expressly fo
parting females. As soon as
male mounts, he is threatene
another. In the melee, most fe
escape while their suitors fight
about one-third of them cop
before reaching the open sea
course, it is the highest-rankin
ripheral male that is most succe

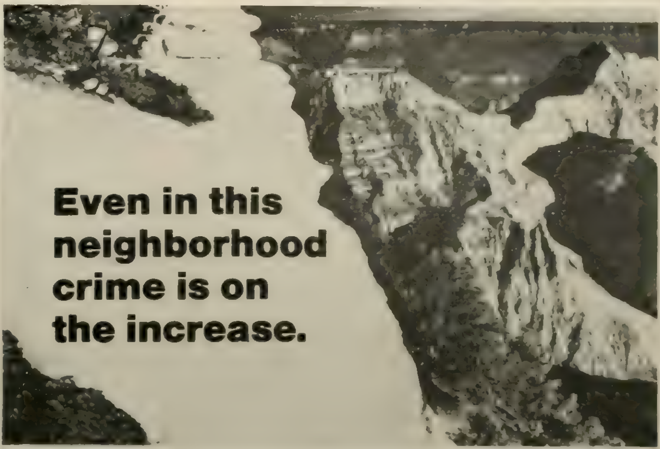
Selection occurs when mati
nonrandom, and in time, the
is evolutionary change. We
seen that mating is restricted
few males during one season. I
estimate the degree of selectio
important to determine how
the same males continue to
nate breeding. Do the same
monopolize the females for
than one season, or is there a
plete changeover from one ye
the next? Do some males
their whole lives without ever
ing, or is it just a matter of r
ing a certain level of maturati
fore a male gets his ch
Tentative answers are beginni
emerge from comparisons of
vidual performances in succ
breeding seasons.

Seven males accounted fo
percent of the breeding in

ve of these continued to do 80 rcent of the mating in 1969 and ur males were still responsible for percent of the mating in 1970. e top two males in 1968 dropped t of the picture almost completely the last two years. GLS, ranked rd the first year, rose to the al- a position in 1969. Although he ntinued to hold this position for first six weeks of the 1970 sea- n, he was deposed and plummeted wn to ninth position when the fe- les started to come into heat. N, who ranked fourth in 1968, proved his position the second ar by competing on the other side the island where he became the ha bull of the small harem. He urned to the large harem in 1970 th about the same rank he had d in 1968, but he did not breed.)'s development is most inter- ing since he progressed from sev- th to second and finally to first.

Evidently, males do contribute to population gene pool for more n one season, but the exact gth of time still remains to be termined. Are former beachmas- s like GL and GLS "all through," will they rise again in the hier- hy? They are both still rela- ely young compared to male CLS o ranked second in 1968 and th in 1969. Will BO be among top bulls in 1971?

Fighting behavior plays an im- rtant and pervasive role in the es of individuals as well as in the cess of the entire species. In a al selection process, the social tem screens the most fit males to e the next year's offspring, thus hancing their viability and that the species. First of all, only ult males, 10 to 12 years or ler, participate in reproductive tivities. Even though males attain berty at about five years of age, se young males cannot compete ectively with their elders for fe- les. Many males die before ching breeding age. Those that rvive must have warded off dis- se and parasites, obtained enough eat, and avoided being eaten by edators. Having passed this fit- ss test, a male must still be althy and strong enough to fight d beat most of his fellow survi- rs in order to breed. His success, e survival in general, is undoubt- lly based on a wide assortment of



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Social rank and breeding success among the seven highest-ranking males in
and their performance in two subsequent years at Año Nuevo Island's large har

	1968		1969		1970	
Males	Social Rank	Percentage of Matings	Social Rank	Percentage of Matings	Social Rank	Percent of Matin
GL	I	37	XII	0	XII	1
CLS	II	31	VI	1	IV	9
GLS	III	14	I	49	IX	2
PIN	IV	4	*		V	0
YLN	V	6	IV	4	*	
TWO	VI	4	VII	4	XV	0
BO	VII	1	II	22	I	28
Total: Percentage of mating		97		80		40

*Absent from harem

genetic traits. Heavy tusks, a thick integumentary shield, and great size are obviously important. The great sexual dimorphism of the species today probably developed over a long period of time as a result of the edge larger males enjoy in fighting. Having stored enough fat to provide for a two- to three-month fast, the breeding bull must time his arrival on the rookery just right; there are disadvantages in arriving too early as well as too late. There are even intellectual requirements; a bull must remember which bulls he has fought and beaten and which have beaten him. Lastly, for about one and a half months, he must be potent, fertile, and willing, again and again. A better system for selecting the fittest males to perpetuate the species would be difficult to imagine.

Aggressive behavior may influence species development in other indirect and less obvious ways. Limits to population growth and the speed with which new colonies are established could both derive from the thwarting of males that attempt to break into the social hierarchy and participate in breeding, causing them to move to other uninhabited islands and mainland beaches. Subadults are most apt to adopt this solution.

The loud, stereotyped vocalizations of bulls may have important functions other than that of threat. Since, under ideal conditions, the sounds can be heard for several miles, it has been suggested, although not confirmed, that the calls may be important in attracting breeding females to the rookeries, particularly to newly established ones. One aspect of the call seems to serve, in part, as the basis
recognition between individuals
Año Nuevo each male consiste
emits a certain number of pulse
his vocal bursts. One male
settle on three pulses while ano
signals threat with five. The
variance of pulse number in s
males can be used to disting
them from others. In additio
this characteristic, further cues
provided by differences in pitch
tensity, and timbre.

Finally, there is suggestive
dence that individuals from
population may be able to re
nize males from another popula
by certain temporal characteri
of the pulsed call, particularly
rate at which pulses are emi
The pulse rate of males withi
single population is remark
constant, but average pulse
varies considerably between p
lations. Males at Año Nuevo Isl
for instance, have a pulse rate
that of males at San Nicolas Isl
which is about 330 miles to
south. Such geographical di
ences resemble the local dia
that occur in birds and man.
liminary evidence indicates
certain aspects of the calls are
ied, which would account for
lack of variation in the calls
single population both withi
single year and from one yea
the next. Dialects may functio
isolating mechanisms acting
combination with geographical
aration to restrict gene flow
tween neighboring populations.
this reason, the phenomenon is
sidered significant for speciatio

Why does an elephant seal fi
Because the consequences are
for him and the species.

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Sky Color

Continued from page 38

sky would be white. Away from the zenith, the sun would be visible only as a faint red disk in a white sky with a bluish tinge, or else it would be undetectable. If the atmosphere is thick enough, scattered light might even provide a twilight over much of the "dark" side.

If the sun can be seen, it must appear squashed and flattened by refraction. This is an exaggeration of the same effect in the setting sun seen from earth, and has the same explanation as the apparent kink in a rod stuck partway into a pool of water.

Light travels slower in a denser medium, three-fourths as fast in water as in air, and slightly slower in air near sea level than at high altitude. Propagation of light in a nonuniform medium somewhat resembles a car moving along the edge of a road with two wheels on the pavement and two on the shoulder. The car tends to turn toward the shoulder, the "medium" in which it moves more slowly.

This means that in the atmosphere a ray always bends down toward the surface. The farther it travels or the denser the air is, the greater is this bending, or refraction. A ray from the top of the setting sun goes through less dense air, and so is bent slightly less than one from the bottom. So the entire sun appears farther above the horizon than it really is; but the bottom is raised more than the top, which leads to a flattening in appearance.

On Venus the setting sun would be squashed like a huge dish facing upward. The horizon, too, would be concave upward so it would look as though you were standing at the bottom of a huge bowl (*see* NATURAL HISTORY, June-July, 1969, *page 54*). In addition to this, different wavelengths are bent by different amounts: red least, yellow and green more, blue and violet most. So the setting sun (if it can be seen at all on Venus) would be red at the bottom and orange above that. Since yellow, green, blue, and violet wavelengths are scattered
strongly, the top of the sun w
only a smudge. This smudg
seem green to human eyes, be
we are most sensitive to that

This happens on the earth,
it is called the "green flash
very clear skies (usually ov
ocean), as the last edge of th
drops below the horizon, a br
green jewellike flash, lastin
than a second, can occasiona
seen.

Its explanation is simple. Tl
has already gone below the hc
Red light, being insufficient
fracted, can no longer reach t
server. The same is true of
light. Blue and violet wavel
are effectively scattered aw
that the green light makes a
impression. Then the sun sink
further and the green also is

Would Tau Ceti I have a
flash? Of course, if there is n
much dust. In fact, dependi
the content of the p
atmosphere, it could have a
or orange flash, too, and if
volves slowly enough, the
could last for minutes.

We began this article with
tacled alien asking his father
the green sunset. Perhaps
seeing a green flash, but Tau
has a day as long as our we
the flash lasts many seconds.

Perhaps, too, they can
their skies another, more fa
refraction effect—the rainbo
eryone has seen rainbows, b
people can say with ce
whether the red stripe is on t
or the bottom (it's at the to
why. But the same features tl
plain the flattened setting su
the green flash are at work he

A rainbow is visible when
shower in an otherwise clear
opposite the sun (or, som
the moon), or when one aims
den spray up in the air awa
the sun. Each droplet acts
little prism, breaking up whit
into its components. Each b
color is a section of a ring ce

nd the line drawn from the sun
ugh the head of the person
ıg it. (Thus, no two persons
y see the same rainbow.) The
r the sun in the sky, the more
bow will be visible. Winter rain-
are larger than summer ones,
noon rainbows are small and
ly seen.

his is only a hint of the variety
intricacy found in rainbows.
ter bows appear outside the
bow, around the sun, and
etimes around the full moon.
are cousins of the rarely ob-
d "glory," and of the corona
the halo.

glory is a set of colored rings
by an observer around his own
ow on fog, a cloud, or dew.
best spot to see it from is a
ntain peak or, more commonly,
irplane flying over clouds. A
na is a ring centered closely
nd the sun or moon. Its cause is
action by cloud droplets, an ef-
related to the fuzzy appearance
bjects seen through a pinhole.

halos, ice crystals take the
of droplets. Sun dogs are an
ple (*page 38*). When the sun
vay from the zenith and slightly
ined by hazy cirrus clouds,
hes of light appear on either
of it, reddish toward the sun.
most halos, they are paler
less varicolored than the best
bows.

ainbows certainly exist on other
ets. As we have seen, the in-
ients are sunlight and clouds of
r droplets. These will certainly
t hand on any earthlike world.
act, there might be many more
bows than here. A planet with a
bright moon or binary stars
by could even have rainbows in
ral parts of the sky at once.

he intensity of rainbows in-
ses with the size of the water
s. Small fog droplets make pale
s, big cloudburst drops make
iant ones. Under the right con-
ons, raindrops can grow quite
e. This depends, however, on
ise details of the atmosphere.

We can speculate that for a planet with a gravitational field weaker than the earth's, raindrops would fall more slowly and thus have time to grow larger.

Water clouds are not necessary for rainbows. Any liquid that forms large enough drops and has a different index of refraction for different wavelengths would lead to similar displays. Jupiter is known to have hydrogen, methane, and ammonia in its atmosphere. If the ammonia forms clouds of liquid drops, the rainbows there would resemble ours.

But our rainbows are probably more beautiful. Jupiter has a heavy cover of ammonia crystals and ammonia "snowflakes" at high altitudes, and very little light must get through these clouds to the surface. This upper layer is tinted with small amounts of sodium and other impurities that absorb some of the visible wavelengths; these traces, plus methane, are probably responsible for most of Jupiter's painted appearance.

Rainbows, sunsets, blue skies, and blue moons—they all have their place in our poetry and prose. To survey sky colors in a brief article, as we have tried to do, omits their impact on the viewer. We have painted with too coarse a brush. "Partly cloudy" misses the difference between a blue sky dotted here and there with little cotton balls, and one with long majestic streaks across it, like plowed furrows. "Sunset" can mean an ordinary sight or a breathtaking one.

In just such a manner, descriptions of skies not yet seen must fail to capture their real impact on a viewer. Subtle effects, tiny details we have no way of imagining beforehand, would make these skies different from the earth's. Only by making the journey to distant planets and stars and seeing the alien heavens at first hand can we learn what they are really like. Perhaps, someday, our descendants will take that epic leap. ■

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The Highlands of SCOTLAND

Continued from page 76

Most red deer thus live on the open hill and may hardly come in contact with trees, far less forests, all their lives. Such deer vary in size, but a reasonable average weight for stags would be 200 pounds, which makes them midgets beside the elk of North America (which are close relatives) and the red deer of Central Europe.

Even so they are fine animals and the largest land animal in Britain. They are, however, different things to different people: they are a famous game animal; they are a favorite with tourists and naturalists; they are potential competitors with farm stock and can raid farm crops; they browse forest trees and sometimes strip bark; they are an important part of Scotland's heritage of wildlife. Red deer are thus viewed very differently by the different users of hill land, and this is where the conflicts lie.

The traditional means of hunting red deer in Scotland, which began about 1850, was to stalk up close to the animals in open country using gullies and knolls downwind to keep out of sight and smell. Usually a stalker, an employee of the estate who knew the lie of the land, guided the hunter.

It became fashionable in the latter half of the eighteenth century for rich industrialists to own a deer forest which they visited for deer stalking and perhaps salmon and trout fishing for a few months of the year. The emphasis was usually on trophy shooting, big, much-forked antlers being especially coveted. The shooting of hinds (female red deer), however, was looked upon as a chore and this shooting was therefore left to the local staff. They usually tended to undershoot and this tendency became more and more pronounced as staff problems on estates during this century became more acute. Added to this was the intuitive feeling of stalkers that if you leave plenty of hinds you will get plenty of fine stags. tually such a policy only insure very high mortality when a l winter comes and a generally p size and antler quality in ad beasts.

The result was similar to that the "buck law" in the United Sta Deer population increased gre and pushed out onto agricultu land on which they should not h been. At the same time, affore tion by the state was proceedi often on a large scale. For hist cal reasons, the Forestry Comn sion was primarily concerned w growing timber and looked on d often rightly, as pests of their ests. Their aim was to exclude d by high fencing. However, the ing of fences took no account of seasonal movements of deer and ten aggravated the conflict with riculture by diverting deer to ara land.

In this climate of opinion, g poaching at night began on a gr scale. Poaching was often bru and many animals were wounded. Even so, it was plauded by some people as a me of controlling a pest. At first a g ernment committee was unable agree on the question of closed sons; later a second committee

In 1958, the Red Deer Comn sion was set up to advise on management of red deer. They h now made a census of most of land occupied by red deer, have found about 200,000 of th They have advised estates on correct cropping rate and the n imum number of deer that an is able to sustain without damag the habitat. The Forestry Com sion also has changed its po toward deer, and is now tryin accommodate the deer by provid access to low ground.

In a similar way, the Fore Commission has reorganized its proach to the roe deer, a small of the early stage of forest suc on, which cause local damage by rowsing small trees and rubbing e bark off. It is very difficult to ep roe deer out of forests, even th seven-foot fencing. Previously e foresters reacted by organizing otgun drives that were unselective d solved nothing. Now, the social ganization of these deer is known d, based on this, shooting is ghly selective. As a result, roe er are no longer a serious prob- m.

This is a time of great change in e Scottish Highlands. Because of revision in tax laws the old idea an estate as a sporting plaything dying. Estates must be made to y their way. And this need comes a time when the traditional ex- nsive hill sheep industry is in dif- ulty because of rising costs and oor shortages. Some estate own- , realizing how well red deer are apted to their hill environment, harvesting deer primarily for nison—a very great break with dition.

Red deer are remarkably free m diseases and parasites. They the hills more efficiently than ep since they can move across contours rapidly as the fickle ottish weather changes. All parts the deer are in demand, the skin, tlers, and canines for trinkets; d the venison, which has doubled price in the last two years, for d. The overhead costs for crop- g deer are smaller than those for rding sheep. There is, therefore, incentive to crop red deer.

Alongside cropping schemes re must be research to guide d management. Already the Na- e Conservancy and the univer- ies are contributing useful work. cash, as well as its sporting, lue will probably provide the red er population of the Scottish ghlands with more efficient feguards than are now provided laws that rarely take changing nd use into account. ■

Afrique.

Questions and answers

1 "What's the difference between Africa and Afrique?"

[illegible]

2 "This is my first trip to Afrique. What do I need to take?"

You don't need to take all sorts [illegible] light, informal wash and wearables. Pack lots of film and get yourself an all-purpose filter for extra strong sunlight. Bring a [illegible] might want to take plastic bags, scotch tape, rubber bands and a few ball point pens. [illegible] and are sometimes difficult to find. Last but not least, take Air Afrique. [illegible] any other airline.

3 "How do you get to and around Afrique?"

[illegible]

Afrique R[illegible] 2-71

[illegible]

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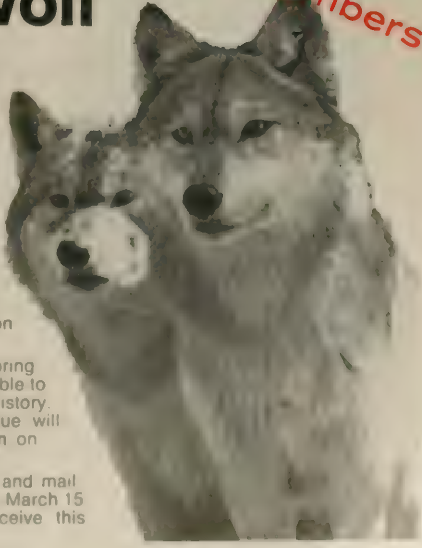

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New subscribers: Fill out and mail the adjacent order form by March 15 in order to definitely receive this record.

Letters

Rock Music

The article "Rock Music" in the December issue of your magazine held particular interest for me. I have an octave of rocks, which I play with wooden mallets to the delight and wonder of all who hear them.

My "rockanola" consists of shards from the shale slides in Provo Canyon to the east of this city. The sound is unbelievably bell-like.

When father (the late Professor E. D. Partridge of the faculty of Brigham Young University) and I returned from Provo Canyon to town with the original set of stones, they were found to be off pitch with our piano. Father chipped one to pitch, returned to the canyon, and came back with a tuned octave. I could then accompany him when he played the little tunes he composed for this instrument.

To start with, it was the musical clink that resulted when we walked over the shale fall that gave father the idea of a rock piano. The tones are placed on rope to aid vibration and clearness of tone. I now play the rockanola by ear.

Until now I thought that my instrument was probably unique.

I do enjoy your magazine.

Ruth Louise Partridge
Provo, Utah

The Social Contract

In my opinion, there is something amusing about a critical review of a book that I like. In this respect, Ronald Singer's discussion in the November issue of Natural History of Robert Ardrey's latest masterpiece—*The Social Contract*—is no exception. His appraisal reminds me of two other book reviews published in this journal: one by T. C. Schneirla of Konrad Lorenz's *On Aggression* (December, 1966), and the other by Evelyn Shaw of Robert Ardrey's *The Territorial Imperative* (March, 1967). Schneirla accuses Lorenz of having outdated negative views, of making (irresponsible) oversimplifications, of basing his argument on dubious assumptions, and of presenting the results of research in the wrong way. Similarly, Shaw feels that Ardrey has shallow comprehension of the complex interactions of animals with their environment, and that he makes disastrous misuse of scientific research by manipulating its findings. Perhaps the reason for their "hostile" appraisals—as suggested by Marston Bates in the April, 1967, issue of Natural History—is that people can be quite aggressive when their particular intellectual territories are invaded.

Anyway, as a great admirer of Lorenz's and Ardrey's works, I find it reassuring to know that it is not the insignificant works that receive the most severe criticism,
rather, the truly outstanding (
butions (which historian ha
his works criticized more than
bee?). Equally reassuring i
On Aggression and *The Terr*
Imperative are receiving far
than a normal amount of atte
as evidenced by the fact that
of the eight contributors to
ral History's special suppl
on war (December, 1967) lis
these books in their bibliogra

More importantly, from my
of view, many college student
essays such as *The Territoria*
perative extremely useful for
ter comprehension of the dyr
of political behavior. After I
familiarized themselves wit
concepts of territoriality, amit
sus enmity, in-group versus
group, and man's need for id
security, and stimulation, the
it easier to understand an
telligently discuss the geop
issues of our time: the Ni
War, the Cuban missile crisi
invasion of Czechoslovakia
conflict in the Middle East, ar
construction of the Tan-Zan
road. The point being tha
though the works of Ardre
Lorenz (as well as those of
mond Morris) may not be w
flaws, their usefulness reach
much further than certain e
in animal behavior, anatom
biology seem to realize. The
able contributions to a wide v
of academic disciplines makes
works truly great. It is in this
that I find the defensive, disc
centered attitude and narrow
cused concern of the reviewe
only amusing, but somewhat
ing as well.

Hendrik J. Re
Assistant Professor of G
University of G

Pyramids

ur nine-year-old son just said your "The Great Pyramid De- " (NATURAL HISTORY, Novem- December, 1970) was the most esting thing he had ever read. I zed that this was his first print unter with differences of opin- and that this is what excited so much. The schools are y of always having right an- or vague "discussions"— ever controversy.

vould like to urge that you ac- seek out such articles, as they represent the life of science.

KIRA GALE
Omaha, Nebraska

Ecological Questionnaire

as fascinated by the tenor of line-Gerlach analysis of re- s to the NATURAL HISTORY y survey in the December is- was particularly intrigued by discussion of those respon- who had undergone, in the au- words, a "commitment ex- ice," either an identity- ng decision or a bridge- ng act, or both, which ned them full-tilt into the y movement. By analogy with "movements" they had pre- y studied, the authors expect uch people will become "sig- ntly more involved in move- activities," and that such will e especially of those who have gone both kinds of com- nt experiences. The authors e to compare the responses of itted individuals, as so de- to those of other respondents. y3 percent of the total sample ed one or the other kind of itment experience and only ercent (56 people) reported both. Such committed individuals are evidently at least two or three times as likely to "interact" frequently with other "movement participants" and to view the ecology movement as one aspect of a single wave of revolutionary change. They are also far more likely to condone violent action for the sake of ecology, although a majority of the committed group, as defined, do not approve of violence, meaning "sabotage or bombings" in the authors' words.

There are several spooky aspects to the discussion I have outlined. For one thing, the purpose of the ecology movement, if we are to call it that, is not to interact among ourselves on a personal level, but to interact with those members of the general public who are not with us yet, and to influence especially those whose duties involve making decisions that matter. To my mind, a forest ranger, a wildlife overseer, a harbor commissioner, or a waterways engineer who never once attends a "movement" meeting of any kind, but who consistently applies sound ecological practice in his daily work, and who argues for them with those who hire him, is more *significantly* involved than the most "committed participant" who never quite finds an effective way to exert influence, even though he tries earnestly in countless hours of talk and confrontation. The name of this game is action at the doing level, and no amount of political action or social interaction can in any way substitute. The earth does not give a damn for our talk or our politics, but only for our actions as part of the actual biological world.

Secondly, I do not quarrel with the authors' analogy between commitment to a movement and conversion to a religion, but the analogy, apt as it is, disturbs me with respect to ecology. No matter how you turn the thoughts around, religion and conversion smack of unquestioning faith, of dogma and of doctrine. If this mood ever creeps deeply into our views on ecology, we are undone. This has been a good part of our trouble to date. Only an open, questing, humble approach to understanding can serve the interests of ecology in the long run. The only recommendation for ecological action worse than good intentions alone is bad intentions alone. The earth does not give a damn what we intend to do, but only how we actually act, often with results that cannot be predicted from a superficial analysis, and that may be discovered only when the earth's reaction sets us straight.

Finally, considering that the committed respondents evidently tend to see ecological concern as but one aspect of a revolutionary social spectrum, I worry lest they isolate themselves within a small political in-group. If such a group tends to use violence as an internally acceptable means of ecological action, rather than as the absurdly egotistical gesture that I hold it to be, I fear the cause of environmental balance can be damaged in the eyes of most. I would argue that societies on earth must strive for sound ecological practices on the working level, no matter how they may wish to arrange their political systems. If a proper public attention to ecology is dependent upon some one form of social organization, all is lost until the world is homogeneous and just so. I do not for a minute believe that such a requirement is either realistic or necessary.

W. R. Di[illegible]
Professor of [illegible]
Stanford [illegible]

Books in Review

Bucking the Power Structure

by E. F. Roberts

THE POLITICS OF ECOLOGY, by James Ridgeway. *E. P. Dutton & Co., $5.95; 222 pp.*

I have a habit of looking for conclusions before I read the bulk of any book. Experience has taught me that an imposing tome that grunts and groans toward a banal finale is more likely than not a banal book. Mr. Ridgeway aided me because this relatively short book ends up with its conclusions neatly collected on the closing few pages. These conclusions are, to say the least, somewhat eclectic, as witness the following propositions. The students who inspired Earth Day only managed to pave the way for the emergence of a new pollution-control-oriented industry, a plague worse than the last because these companies actually thrive on pollution. The government should tame the oil industry by abolishing its depletion allowance, doing away with the import quota, and fixing standards for pollutants in the resultant product. The government should launch a vast research program to develop a new way to power motor vehicles while it constructs mass-transit systems in the cities. The government should shut down all plants that pollute and make "the companies" pay for installing the proper antipollution equipment out of "profits," insuring that they do by not giving "them" any tax breaks and by fixing maximum prices. (Did anyone ever tell the author that a lot of retired working-class people might be living off these profits?) When taken together, these nostrums almost open up the possibility for "revolutionary change," but not quite. That is, after all of this, we are told that there is nothing much that can be done about pollution until we "achieve some fundamental idea of community and a political economy." Banal? If one has ever taught a college-level seminar on the environment, yes. Indeed, they would seem banal to anyone halfway literate who has participated in a stimulating conversation about our environment within the past calendar year. Indeed, they were so banal that my curiosity was actually aroused as to how the author had presented them to his public, and I delved into the body of the book to learn more.

According to Ridgeway, the ecology issue offered liberal-minded people a peaceful way to reform capitalism while it gave the Nixon administration a device to divert all of us from thinking about Vietnam. This appearance of concern is deceiving, however, because behind the scenes the industries that pollute our waters are quietly taking over the water pollution programs so they themselves can control, and actually profit from, a slow-moving cleanup. Government regulation of water pollution has been nothing more than a "private preserve for opportunistic politicians" ever since Theodore Roosevelt established the coalition between government and big business. The list of villains since then has been long, running the gamut from James R. Garfield, a "leading conservationist" who aided oil prospectors; through Harold Ickes, who saw no problem; to Stewart Udall, who wanted to "capture" the water pollution program in order to enhance his own prestige. Meanwhile, to make matters worse, the oil industry has been up to its old tricks and has been busy building a giant cartel that will permit a few companies to control all of our energy sources. To this end, they own natural gas, are buying up the coal industry, and are rigging the research done in other fields to slow down the emergence of a viable alternative. Bad enough that we have to suffer polluted water because our politicians are corrupt, and have to face again the specter of an all-powerful oil trust controlling our entire fuel supply, "neo-Malthusians" are now throwing sand in our eyes with a lot of irrelevant nonsense about population growth being the cause of our woes. Henry Fairfield Osborn and Frederick Osborn had to back off their eugenics line with the rise of fascism, but William Vogt and, more recently, Paul Ehrlich have kept the diversion alive even though the whole movement continues to remain "ambivalent about democratic traditi

Will no one stand up for a d
environment? Herein enter
Commoner and Ralph Nader.
moner apparently represents th
entists who want to dominate
their technological expertise, a b
form of capitalism. The enviro
tal lawyers want to undo the u
alliance between government
business by reforming the regu
agencies. Nay, these lawyers ac
yearn for a return to the free n
and, motivating them, is the vis
a new governmental system
nated by the lawyers.

What is one to make of
Frankly, I was at a loss to k
had, however, a sense of havin
through an experience like th
fore. At first I was reminded o
taigne's observation that the
burly of this world is
concerned with gaining a
profit from the public; but
wasn't that. What I was being
to recall were my law schoo
when, for lack of anything be
do, I used to hang around
couple of Hearst reporters d
the courthouse in Boston. Thes
yonesque characters always kn
"real story"—worse even than
would dare to print—abo
phonies, crooks, and charlata
make up the whole of our
The trouble with this milieu is
eventually dawns upon even th
ardent fan of H. L. Mencken
eryone in authority could no
phony, or that if these self-an
protesters are really so righ
should get politically active a
the charge to the barricades
away with the whole system
far, battered but unbowed, the
stands.

I double checked my reac
rereading this book—and, da
was right. Between pages of
scoop, low-down, Hearst-style
tion and innuendo, there wa
larded sophomoric reportage
the obvious: a simple recour
the work of Sir Edwin Chad
nineteenth-century England,
planation of sewage treatmen

Continued on p

Two books—one advocating working within the system, the other proposing to dump it—deal with the dilemma of an insensitive government and offer opposing diagnoses and remedies

George M. Woodwell

FENDING THE ENVIRONMENT, by Jo- h L. Sax. *Alfred A. Knopf, $6.95; ? pp.*

Santa Barbara business executive summed up the mood of the citi- who have dealt with our official rdians of the environment:

We are so goddamned frustrated, whole democratic process seems be falling apart. Nobody responds us, and we end up doing things gressively less reasonable. This n is going to blow up if there isn't ne reasonable attitude expressed by . . . government. Nothing seems happen except that we lose.'"

he words applied to the oil spill, they might have been uttered by of the millions who have ques- ied the apparently inexorable, my- al growth of superhighways, the tern of use of pesticides, the han- ng of wastes, pollution of air, land- zoning, supersonic planes, or any he score of other blessings-turned- cities that have conspired in the sion of life in the United States in ent years. The frustrations have ny sources but they all culminate the insensitivity of government to broadest needs of the governed; the fact that government is quently more sensitive to the well- anized special interests of ex- iters than to its job of assuring the nmon wealth.

Currently there is a tendency to be- e that we have always had these blems and have only recently rec- nized them; to think of the present blic concern as a fad that will pass, wing a return to more con- tional issues. While there is no stion that public interest follows les, there is also no question that forces driving the set of problems ognized as the "crisis of environ- nt" have such power and momen- n as to guarantee that the crisis l progressively dominate human irs and will require some extraor- nary adaptations of government if nplex technological societies are to ntinue to evolve or, perhaps, even to rvive. The basic cause is the double crush of growth of population and technology. More people with an ever increasing command over energy and the technology to use it require an ever more highly integrated society: they require more rules to live by. Frustrations arise when the rules are not forthcoming, or worse, when they are not enforced. There is no turning back; the problems become more numerous and more acute, and the solutions, if they are to be found in the realm of popular governments, lie in the continuing evolution of government in response to these more complex needs. Joseph L. Sax has written brilliantly about one of the most promising contemporary steps in the evolution of government: use of the courts to defend the public interest.

We ask with good reason why use of the courts for this purpose is an innovation in the latter moments of the second century of the Republic. The answer lies in the doctrine of sovereign immunity, "the king can do no wrong," still far from dead in our governmental and legal system. Since the "sovereign" represents the public interest, a court challenge to government on behalf of the public is assumed to be inappropriate, and such cases have routinely been rejected by the courts. The principle is, of course, preposterous, and Dr. Sax shows it, revealing also how court challenges in the public interest are essential to proper operation of government.

Many environmental problems involve fundamentally simple issues for government. They are manipulated into complex issues by those who stand to profit, who can afford to cultivate the proper connections in government. "Money can always wait" was a casual remark in the "fiasco at Hunting Creek," but Sax shows that it is a principle. The fiasco initially involved a 4.8-acre tract at the confluence of the Potomac and Hunting Creek, between Washington and Mount Vernon. The land had been sold for more than $150,000 per acre. Developers, whose identity was largely masked by incorporation, sought an additional 36.5 acres of adjacent, shallowly submerged land from public ownership as well as the right to fill it. The procedure was almost routine. A bill quickly passed the Virginia House of Delegates unchallenged. The price for the land: not more than about $1,600 per acre. But the Corps of Engineers must pass on filling such lands—and the Department of the Interior must offer an opinion. As if to complicate matters, the public is increasingly aware of its interest in such questions. The machinations over the land, spanning more than a decade, involved governors, high federal officials, members of congress, senators, a city council, and various citizens groups. Such is the power of developers. Also involved was a double reversal of position by the Department of the Interior, a series of congressional hearings, and a lawsuit. The issue was "resolved" most recently by a new, and since departed, Secretary of the Interior, Walter Hickel, who saw an opportunity to clarify in one simple action an issue that had been muddled under his popular predecessor. Hickel simply reinstated the Interior Department's opposition—and the permit to dredge was denied. But as Sax observes, "money can always wait."

There is no dearth of such tales, and they make up the raw material of this book. Sax is a master raconteur and interpreter, drawing out his points, one by one, with the skill of the jurist he is. Government is attuned to the exploiters of environment, who have powerful incentive to build and maintain their political and governmental alliances. The interests of restraint are poorly represented, usually disorganized, poorly financed, often naïve, and almost always feeble. The power structure works easily in the direction of the exploiter: the broader public interest, the specific mission of government often falls by the wayside, the victim of cumulative "suboptimizing." Thus the political compromise leads [illegible] to erosion of the public interest, however high the ideals of officials.

Sax sees the role of the [illegible]

(Continued [illegible])

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MR. AND MRS. G. N. LEINBACH
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by E. F. Roberts *The Politics of Ecology, from page 102*

odology (without any reference to tertiary techniques), a simplistic explanation of the Federal Water Quality Act. (The author was honest enough to append notes that aptly illustrate that an intelligent junior high school student could have done the same work.) Believe it or not, I then followed my usual practice and read the material on the dust cover and, lo and behold, what did I find? The author is said to be a contributing editor to the *New Republic* and an editor-founder of *Hard Times*. Better yet, that expert with the tape-recorded sob story about the recent past, Studs Terkel, told me on the back of the dust jacket that this was a "brilliant chronicle of an obscene phenomenon." Brilliant or not, this obscene book is simple Hearst yellow journalism.

But what am I to suggest to the readers who have followed this review? I should simply like to say this. Any author who can, by clever innuendo, imply that some of the founders of The American Museum of Natural History were fascists owes a great deal to a senator from Wisconsin. Any author who can dash off some unsubstantiated inside scoops about the dishonesty of almost everybody, sandwiching them between pages of footnoted triteness, must be persuaded either that he is a scholar or that his readers are idiots. Again, the error of both assumptions wo be manifest to a fairly intellig high school student. Any author w can scream that everyone else is phony and collect royalties on an ercise like this has a hell of a ne But it may not be the author's fa because every once in a while we told that he has the peculiar insi to a truth the rest of us don't ha That is, this book suggests, withou bit of explanation, that somehow are being given the recipe for "op ing up the possibilities of revoluti ary change." If this piece of c commercialism is the recipe, I h with disavow my Marxist sympat and, in search of wrong but at l honest stupidity, announce my giance to Jim Buckley.

But let me conclude on a seri and sincere note. Our environme crisis is far too deadly a matte play more than momentary ga with; we face an issue that may well mean that we must answer lif death questions about the future velopment of this society and, force, ourselves. I recognize that a of entrepreneurs will make a buck manufacturing antipollution vices, but this is a price I am read pay if they work. I realize that m lawyers will wax rich, building reers as environmental lawyers, b their efforts improve things, I willing to pay. I am not willing

by George M. Woodwell *Defending the Environment, from page 10*

sees government in a crisis of function, commonly more responsive to the politically and financially powerful than to overriding public needs. The problem is, to him, not so much a need for interpretation of a correct or desirable course, but rather putting the public interest on a plane equal to that of the most powerful special interests. This of course is precisely what the courts do well, resulting in what he calls "activating the democratic process."

My own limited experience in using the courts to address the issue of pesticides has led me, as a scientist, to hope for somewhat more from the courts than Sax believes they offer. The courts are potentially a link between science and human affairs, insulating against the arrogance of elitism—scientific, technological, military, and political. The technical questions of the pesticides issue, which Sax did not treat, have been unclear, muddied by commercial interests with much help from appare knowledgeable scientists. The co have served on this issue not si as an equilibrator but as a preci tool, extracting, testing, and uating truth as it bears on public icy. The courts offered opportu for a test of the conflicting view scientists—and on pesticides the entific community is far from un Not until court tests became pos was there any appreciable chang pesticides policy, despite more two decades of pressure thr "normal" channels. Other issue science and public policy are p ably not greatly different: scienc not monolithic, infallible, or even commonly right. Where science b on public policy, it needs testing fore the most rigorous court. Sax vides the reasons why courts want the job and will tend to du if they can, preferring to remai curely bound within the "mind-fo manacles of the law." But the ne for environmental sideshows de- ed, not to help solve the crisis, merely to exploit it. Mr. Ridge- , however, is not the only culprit. universities and publishers who concocted half-baked courses books about the "environment" equally guilty. The presidents, rnors, and mayors who have re- ed programs "environmental ac- " are likewise guilty. College ad- istrators and politicians have ays tended to appear to be "re- nsive" and to dress things up with y titles, but no one has ever been n in by their sorry antics. Manu- urers of one-night cancer cures, ever, are guilty of economic es, more serious in my book than le murder because they defraud people as a whole. Along with any epreneurs peddling ineffective an- llution equipment, I accuse au- of nonconstructive books of g guilty of the very same eco- ic crime. Thus, to borrow from Ridgeway's own implicit logy, I would, if I had the author- out him up against the wall. He, I k, is really kidding around; *I am* So much then for his ragtag in- tion of revolutionary doctrine. As his book, let it be mercifully and kly forgotten by all concerned.

. Roberts is a professor at Cornell ersity Law School.

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t, and the courts' experience in aising evidence, and in making sions in the public realm based hat evidence, provides a poten- sensitive coupling between an easingly complex scientific realm an even more complex political

x writes this book from a brief rich and telling experience as essor of law at the University of higan. He is author of a model enacted in Michigan that pro- for court actions in defense of nvironment. He writes with metic- accuracy from an exhaustive ground, lucidly and entertaining- omfortable and easy in his author- It would have been easier for to write for his peers in law; he chosen instead the most difficult ctive, the general reader, and has ned out with the brilliance that is own mark in trade. The book is at a chronicle of an important step ne evolution of government and a

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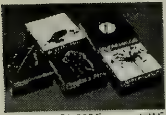

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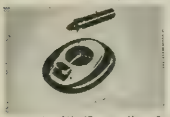

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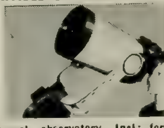

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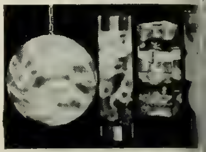

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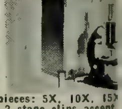

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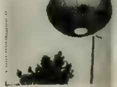

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Woodwell is senior ecologist at
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harles P. Mountford. *Humanities*
s, *$8.00; 143 pp., illus.* PEOPLE
THE DREAMTIME, by Douglass
in and David R. Moore.
ker/Weatherhill, $12.95; 136 pp.,

ough a timely coincidence in
blishing, two new picture books
t Australian Aborigines have
appeared, which complement
other almost perfectly. *The*
igines and Their Country con-
of photographs taken by Mr.
ntford during his long career as
nthropologist and writer. His pic-
emphasize the traditional cul-
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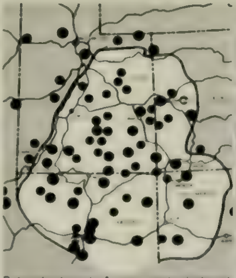

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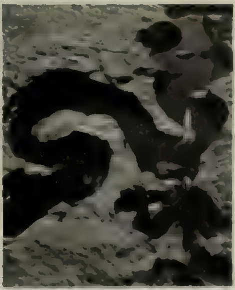

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there were still relatively large numbers of Aborigines living under nomadic conditions in the bush. Many of these pictures have appeared in earlier publications by Mr. Mountford, but for American readers they should retain their original freshness and impact. As one who has spent several years living in close contact with Australian desert Aborigines, I found the black-and-white photographs did much to capture the dignity and character of these unique people. I particularly enjoyed the pictures showing such food-getting activities as collecting wild yams, winnowing desert grass seeds, carrying a kangaroo back to camp, and others. Although one can still witness Aboriginal ceremonies in many parts of Australia today, scenes such as these are becoming increasingly rare.

The book, however, contains s
editorial horrors. One picture o
desert corkwood tree appears twic
once in black and white and o
again in color, and the color re
duction is generally poor, with no
than five out of a total of ninet
color plates being blurred. Ne
theless, on the strength of the bl
and-white pictures alone, the b
should be judged a success.

People of the Dreamtime foc
more explicitly on the plight of
Aborigine in relation to mo
Western society. The last two c
ters give particular attention to p
lems of Aboriginal employment
education and to the dislocat
caused by a long history of
crimination against Aborigines
white Australians. The photogr
in this book are generally

FLYING BIRDS, by David and Katie Urry. *Harper & Row, $7.95; 192 pp., illus.*

It is no simple matter, even with still photography as advanced as it is, to produce a book of photographs
on bird flight that even suggests
real complexity of the subject, b
my mind, *Flying Birds* succeed
doing just that. The authors are
satisfied with one picture showi
herring gull soaring or a puffin a
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aling than those in Mountford's me. but this is not the fault of the ographer. The pictures present onest cross section of life as it is today by most black Austra-. Because their lives are not espe-y pleasant or attractive, neither he photographs. People in cast-lothing squatting on the fringes hite settlements, enveloped in an sphere of boredom and flies, can depressing subject for the photog-er—essayist. The book is a plea white Australia stop ignoring the s of its black citizens.

th books evoke, rather than in-. The emphasis in each volume is he pictures, rather than on any led discussion of Aboriginal cul- The reader who wants a fuller rstanding of the scenes portrayed any of the pictures may be frustrated by the overgeneralized discussions presented in the text. This is particularly true where ceremonial scenes with elaborate body painting and dance paraphernalia are shown, followed by cryptic captions such as, "The rain dance," "The sacred wanigi in the Emu rituals" (no explanation here of what a wanigi is or what it represents), and "Scenes from ceremonies at Derby and on Elcho Island" (ceremonies about what? and for what purpose?). Thus for someone wishing to acquire a knowledge of the Australian Aborigines, both past and present, these two books are no more than a first step and will need to be supplemented by other, more detailed sources. But they are a good first step.

RICHARD A. GOULD
The American Museum

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ces, a number of aspects of , along with informative com-s. Their purpose is to reveal ional beauty, and in this respect picture is not isolated, but adds e next. This is not a highly tech- book, but there is an education all the same. The fine quality of pictures proves that David and Urry are not only good at their ut that they are also careful ob-rs, with a gift of seeing that re- variety.

ere is more to bird flight than re accustomed to think of in a anical age; its perfection is the of millions of years of evolu-ry change. The adaptability in n of a tern or a gannet is in-ed with the wonderfully varied e of the environment on which it endent. The comparison of bird with human flight seems in-priate, however, if only in the the authors present: "One d of flight is to travel through ir, deriving a lifting force from ir that is passing. In an aero- the engines supply the propul-force, the wings providing the The bird's wings perform both and are correspondingly more lex."

e majority of the species in this are coastal birds from Great n, from "summer shores and is-." but with a few exceptions, the or allied species can be seen off ican shores. The ease and grace tern, the splendid, long-winged of gannets, the wheeling of kit-es, the vigorous landing actions cormorant, belong in fact to all rth's dramatic shores.

The sequence of pictures on arctic terns is exceptional in revealing their beauty and ability. The photographers also had their lens on fulmars, seemingly motionless over the water at heights beyond the cliff level where the Urrys were standing; and on the herring gulls, as their wings beat backward and forward while making a landing. There is a remarkable photograph in this book of a razorbill—wings, body, tail, and feet spread as it lands, so as to offer the greatest possible area of resistance—and another of a tern with its wings thrust over its head, and many others, combining to make this a beautiful and informative book. The price, incidentally, seems very reasonable.

JOHN HAY
Cape Cod Museum of Natural History

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Walden and Other Writings. H. D. Thoreau. Doubleday & Company, Inc., Garden City, 1970.

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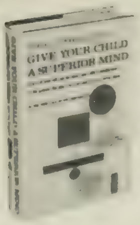

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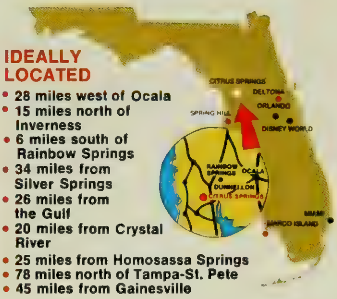

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14 AN OCTOPUS TRILOGY *F.G. Wood and Joseph F. Gennaro, Jr.*
Except for a small jar of telltale connective tissue, the secret of the giant octopus lies locked in the vast unknown of the sea.

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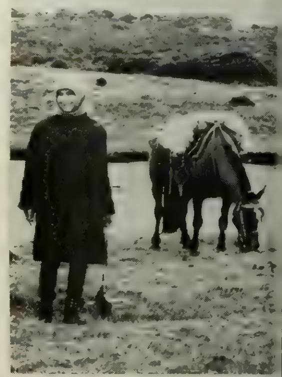
F. G. Wood is a senior scientist and consultant with the Ocean Sciences Department of the Naval Undersea Research and Development Laboratory at San Diego. His primary research areas are the behavior of fishes, octopuses, sharks, and marine mammals, especially porpoises. Formerly director of exhibits at Marineland, Florida, and resident biologist at the Lerner Marine Laboratory on Bimini, Wood received a master's degree in biology from Yale University. His favorite exercise, he reports, is watering his bonsai.

An authority on animal venoms and toxins, **Joseph F. Gennaro, Jr.**, has experienced some peculiar effects of poisonous snakebites on tissue and bone. He first met Wood while researching venom glands in octopuses and became interested in his account of an alleged giant octopus that had washed up on a Florida beach in 1896. The three-part article on this giant octopus is the chronicle of their attempt to conclusively identify the creature. Gennaro received his B.S. in biology from Fordham University and his M.S. and Ph.D., both in zoology, from the University of Pittsburgh. Now associate professor of biology at New York University, he is studying ion transport problems in cells, using electron microscopy. He is the author of "The Gecko Grip," which appeared in the August-September, 1969, issue of NATURAL HISTORY MAGAZINE.

The evolution of Pacific birds has been the major research area of **Dean Amadon,** chairman of the Department of Ornithology and Lamont Curator of Birds at The American Museum of Natural History. Amadon, president of the John Burroughs Association and a former president of the American Ornithologist's Union, received his Ph.D. from Cornell University. He has written numerous books and articles, including the recent *Eagles, Hawks and Falcons of the World* (with Leslie Brown) and *Birds Around the World.* Previous articles
for NATURAL HISTORY MAGAZ
include "Wild Turkey's Retu
November, 1960; "Familiar Sh
Birds in Japan," April, 1963;
"Gotham's Birds," April, 1969.

While on an archeological
pedition to Tierra del Fuego, **Ar**
M. Chapman met Lola, the
member of the now virtually ext
Ona Indians (Selk'nam) to
practice pure tribal culture. Ch
man lived with Lola for sev
months and made extensive rec
ings of her ceremonial chants,
cabulary, and descriptions of S
nam culture. Chapman's article
appeared in a volume hono
Claude Lévi-Strauss: *Echanges*
communications: Mélanges offer
Claude Lévi-Strauss, published
year by Mouton & Co., The Ha
With a team of French physici
she is currently studying the
logical effects of inbreeding am
the isolated Jicaque Indians of
duras. She took her Ph.D. in ant
pology at Columbia University
is associated with the Laborator
Social Anthropology at the M
de l'homme in Paris.



The author of "Coral," **Fr**
erick M. Bayer, is professor
marine science at the Universit
Miami. Specializing in shallow-
ter octocorals, his field work
taken him to the Marshall
Caroline Islands, West Africa,
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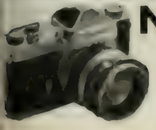

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the Bahamas. He has been an associate curator with the U.S. National Museum of the Smithsonian Institution. Bayer holds a B.S. in zoology from the University of Miami and M.S. and Ph.D. degrees from George Washington University.

The attempt to capture on film his fascination for the sea and its life-forms launched **Douglas Faulkner,** the photographer of "Coral," on his career at the age of nineteen. He studied marine biology at the University of Miami and has traveled throughout the world on photographic assignments. Faulkner took the photographs for *The Hidden Sea,* written by C. Lavett Smith, and served as a consultant for the "Life Nature Library" book *The Fishes.* His work is on permanent display at The American Museum and the Natural History Museum of the Smithsonian Institution.

A native New Yorker, **Daniel R. Gross** is an assistant professor of anthropology at Hunter College. He has a B.A. in philosophy from the University of Chicago and a Ph.D. in anthropology from Columbia University. Focusing on northeastern Brazil, he has done extensive research into religious pilgrimages, social structure, and food ecology in traditional societies. Gross and his Brazilian wife plan to return to Brazil to study the cultural ecology of Gê Indians.

The physiological, genetic, and ecological hazards of the military's defoliation program in Vietnam were the most hotly debated issues at the AAAS Herbicide Assessment Commission meeting in December, 1969. At that time, **Arthur H. Westing** was serving as ecologi adviser to the Royal Government Cambodia, and when the AAAS s a study commission to Vietnam August, 1970, his experience Indochina made him the logi choice for director. "Ecocide Indochina" describes some of t physical effects of the war. Westi chairman of the Department of ology at Windham College, recei his Ph.D. in forest management a silviculture from Yale Universi He is now studying the physical fects of herbicidal agents on anim

Lester Short is a curator in Department of Ornithology of T American Museum and an adju professor at the City University New York. He has observed bi in every state except Hawaii a has done ornithological studies Europe, Mexico, Bolivia, Peru, gentina, South Africa, and Cameroons. The coauthor w Ernst Mayr of *Species Taxa North American Birds,* Short written scientific articles on hybridization, evolution, ecolo and behavior of birds, particula woodpeckers. A book on wo peckers of the world is in prepa tion. His plans for field work clude a study of parrots Australia. Short received his B. and Ph.D. in vertebrate zool from Cornell University.

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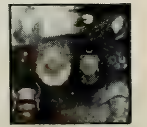
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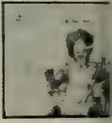
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After a decade of sleuthing, it can be safely said that the gigantic mass of tissue that washed up on the beach at St. Augustine in 1896 was the remains of an octopus that must have measured, from the tip of one tentacle to the tip of the opposite tentacle, 200 feet. Yes, Victoria, 200 feet

PART 1

Stupefying Colossus of the Deep

by F. G. Wood

Accounts of giant octopuses have een recorded in the annals of sea onsters, but learned men who ave reviewed the fragmentary evi- nce have usually assumed that ich reports either exaggerated the ze of the octopus or mistakenly lentified what was actually a giant uid.

This is not surprising. Giant uids are known to exist. They ave been examined and photo- raphed by scientists. It is gener- ly accepted that they may reach a tal length of 60 feet or more. The vidence for gigantic octopuses, on e other hand, has consisted of artial sightings and secondhand counts, the reliability of which ave been open to question. De- riptions have generally been in- mplete and could apply either to ctopuses or squids.

Although both are cephalopods ith similar features, octopuses dif- r markedly from squids. Octo- uses have eight sucker-bearing rms, all of about the same length; uids also have eight arms, but in ddition possess two tentacles capable of being extended far beyond the tips of the arms. The ends of the tentacles are expanded and flattened and covered with many close-set suction cups. Octopuses have bulbous bodies with no skeletal structure. A squid's body is elongate with a stiff internal "pen" and two horizontal fins at the end.

These anatomical differences reflect different ways of life. The octopus is (with a few exceptions) a bottom-dweller that feeds on bivalves and crustaceans. The streamlined squid is a swift and active swimmer that pursues fishes, capturing its prey by shooting out its two long sucker-bearing tentacles.

Despite these differences, the identification of a giant cephalopod can be difficult, especially if only a brief glimpse of the monster is possible, or if only a portion of it is recovered, as from the stomach of a sperm whale, which feeds on cephalopods. It is perhaps not surprising that Bernard Huevelmans, who has reviewed in exhaustive detail the available knowledge of sea monsters, is inclined to interpret all accounts of huge cephalopods as referring to the giant squid, which is known to science, rather than to the giant octopus, which is not.

Is the giant octopus but a mythical beast? The following account chronicles a search that began with a newspaper clipping and extended back more than 70 years to the discovery on a Florida beach of a monstrous sea creature that may have been a true giant octopus.

In 1957, the files of the Marineland Research Laboratory contained the accumulated papers of almost 20 years. I was looking for some notes I had made on the behavior of octopuses when I happened on a newspaper clipping I hadn't seen before.

It was an "illustrated feature," slightly yellowed with age, entitled "The Facts About Florida." Most of it was devoted to a drawing of the artist's version of an octopus. Under the drawing was a caption:

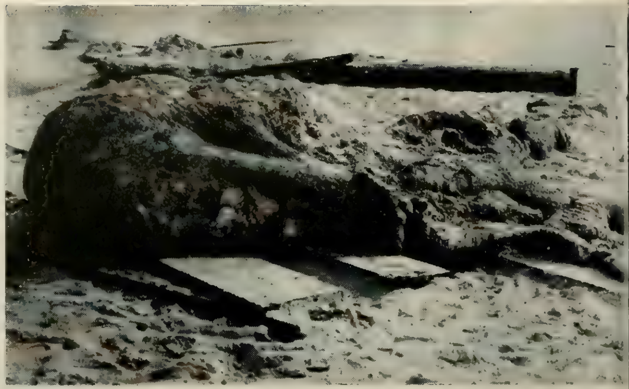
"In 1897, portions of an octopus, said to have been more gigantic than any ever before seen, were washed up on the beach at St. Augustine. Prof. Verrill, of Yale University, who examined the remains, which alone reputedly weighed over six tons, calculated that the living creature had a girth of 25 feet and tentacles 72 feet in length."

This was hard to believe. The largest known octopus is generally considered to be the North Pacific species, *Octopus dofleini*, which reportedly reaches a weight of 125 pounds and may span—arm tip to arm tip—20 feet or more. The octopus described in "The Facts About Florida" surely belonged in the category of fictitious sea monsters. Yet the caption included several items of information that could not be quickly dismissed. The date and site of the finding were given. St. Augustine Beach, an oceanside resort just below St. Augustine, Florida, was only 16 miles up the coast from the Marineland Research Laboratory where I worked. And Prof. A. E. Verrill of Yale had been, at the turn of the century, a noted authority on cephalopods. It was Verrill who had written most of what was known about the giant squid. I had for some time been particularly interested in octopuses. Verrill's name, along with a specific year and place, was enough to set me digging.

The clipping bore neither the date nor the name of the newspaper from which it had been extracted. Nobody I talked to could remember ever having seen an illustrated feature called "The Facts About Florida." The St. Augustine paper was obviously the first place to direct an inquiry, but I learned that the newspaper building, with all of its files, had been completely destroyed by fire a few years after the date given in the clipping.

So remarkable a find might have been mentioned in *The New York Times*, but my inquiry was answered with a card stating that the scope of their service was restricted to current events and suggesting that I consult their indexes and files at Florida State University in Tallahassee.

In the meantime I had written to the state librarian in Tallahassee. She informed me that the files of *The Florida Times-Union*, published in Jacksonville, had been indexed as a WPA project during the depression and the index turned over to the Jacksonville Public Library.



Looking vaguely like an elephant lying on its side, the remains of a giant octopus lie across planks on a St. Augustine beach.

My letter to the Jacksonville library brought a reply corroborating the information in the clipping, and a few days later I received a photocopy of a page from *The Florida Times-Union* of Tuesday, December 1, 1896. In a brief article the dimensions of the creature were described as 22 feet long and 6 feet wide, and it was referred to as "apparently a portion of a whale. . . ." But "President Webb," identified as the president of the [St. Augustine] Scientific Society, had examined the monster and pronounced it to be an octopus.

This brought my search back to St. Augustine, and I inquired at the local historical society, as I should have done in the first place. There I learned that Dr. DeWitt Webb had been a physician with a bent for natural history. He was apparently a knowledgeable man. As later information made clear, he had good reasons for identifying the huge carcass on the beach as that of an octopus.

The files of the St. Augustine Historical Society contained a clipping from the *New York Herald* on which someone had writen the date, January 3, 1897. Illustrated with a rather good drawing of an octopus,
the article's headlines emphasi
the more spectacular details, but
text provided additional interest
facts. The body of a colossal
topus had been found cast ash
on the beach about 12 miles so
of St. Augustine. It had evider
been dead for some time and
much mutilated. "Its head
nearly destroyed, and only
stumps of two arms were visi
. . . . The body, as it lies somew
imbedded in the sand, is 18
long and about 7 feet wide, whil
rises 3½ feet above the sand. .
The weight of the body and h
would have been at least four
five tons. If the eight arms held
proportions usually seen in smal
species of the octopus, they wo
have been at least 75 to 100 feet
length and about 18 inches in dia
eter at the base."

The remainder of the arti
written in the first person but wi
out a by-line, cited further det
that had been provided the wri
by Dr. Webb and mentioned pho
graphs that Dr. Webb had taken.
conclusion it reviewed what
known at that time of the lar
cephalopods, including the gi
squid.

So authoritative was the lat
portion of the article that it
peared to have been written by V
rill himself. In a letter to the edi
of the *New York Herald*, publish
in the March 14, 1897, edition, P
fessor Verrill alluded to an earl
article about the giant octopus t
he had written for that newspap
But now, at this later date, he wish
to retract what he had said before
Stating that his opinion as to

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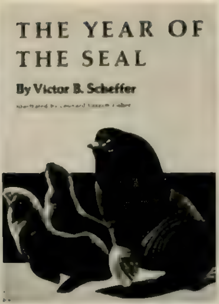

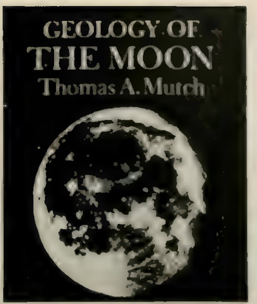

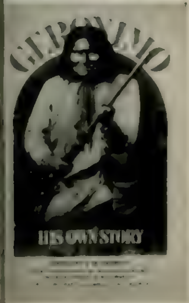

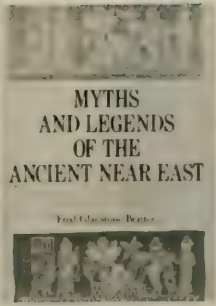

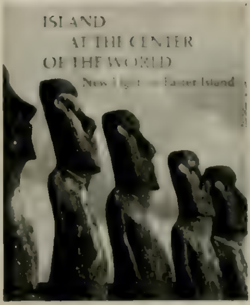

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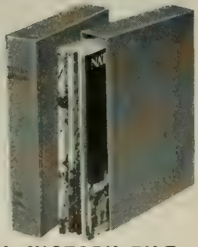

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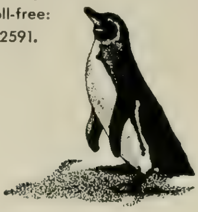

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identity of the creature had be based entirely on the general fo and appearance, as shown by ph tographs, and on information th "a part of an arm 36 feet long h been found attached to the he when it was cast ashore," he we on to say that this later stateme was certainly untrue. He had ju received from Dr. Webb some lar masses of the exterior skin, fai well preserved in formalin. The were "from three to ten inch thick, white, firm, elastic, and ve tough."

They were composed, Verrill co tinued, of "very tough elastic bers, much interlaced and bound gether. This structure is like that the blubber of some whales, b there is very little oil in th masses. There are some irregu cavities and canals in some of t pieces.

"We must conclude, therefo that the creature was a vertebr animal, probably related to t whales.

"But I am unable to refer t immense, closed, pouch-like mass any part of any known whale, or, fact, to any other animal. . . ."

The monster still intrigued m and I was not convinced that V rill was correct in his suggesti that it was some kind of whale. anyone who has dissected a wha even one long dead, the "very lit oil" is especially significant. T blubber that lies just beneath t skin of a whale is rich in oil. wh cephalopods possess very little fat tissue.

Searching further, I learned th Verrill had described "The Flori Sea Monster" in an article that a peared in *The American Natural* of April, 1897, and that had o viously been written before he h changed his opinion as to its n ture.

In this article he presented ad tional intriguing details, all, it a peared, obtained from Dr. Web Although the monster had been ca ashore in an advanced state of d composition, it had "contrary to e pectation . . . resisted further d cay, and still remains, after thr months, nearly in the same state at first." Verrill alluded to a doz different photographic views he ha obtained from Dr. Webb, as well "several large masses of the thi

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and firm integument" that Dr. Webb had sent him. Drawings, made from the photographs, were included in the article.

Gilbert L. Voss of the University of Miami Marine Laboratory (now the Institute of Marine Science) provided me with five additional references from his extensive files on cephalopods. (He also told me that in the collection of the Smithsonian Institution was a large jar of preserved tissue bearing the label *Octopus giganteus* Verrill, but let me come to this later.)

A prolific writer on the mystery animal, Verrill ultimately reversed himself in scientific journals, as well as in the public press.

His initial report on the creature appeared in the *American Journal of Science* in 1897 under the title, "A Gigantic Cephalopod on the Florida Coast." After quoting from a letter written by Dr. Webb to a R.P. Whitfield, he speculated that the remains might be those of a giant squid, perhaps a species of *Architeuthis*. In the same journal later that year, Verrill quoted additional details received from Dr. Webb and indicated his agreement with Webb's identification by proposing the name *Octopus giganteus* for the creature. This account, entitled, "Additional Information Concerning the Giant Cephalopod of Florida," contains a significant statement:

"Dr. Webb writes that a few days after the photographs were taken (Dec. 7th) [the one accompanying this article is believed to be one of these]excavations were made in the sand and the stump of an arm was found, still attached, 36 feet long and 10 inches in diameter where it was broken off distally."

But in a still later issue of the same journal under the title "The Supposed Great Octopus of Florida; Certainly Not a Cephalopod," Verrill retracted his earlier opinion as he had in his letter to the *New York Herald*. "Additional facts have been ascertained and specimens received, that render it quite certain that this remarkable structure is not the body of a cephalopod." Defending his earlier position, he says that "many other zoologists who examined the photographs held the same opinion. Some of those who have seen the samples of integument [covering, or skin] sent to me still believe t the specimen may be the body some unknown genus of Ceph poda allied to *Octopus*. But thick integument of a cephalopo necessarily muscular and hig contractile, while in this creatur is elastic and resilient, and not all contractile. Therefore, I can refer it to that group. . . ."

He also quoted, in a footnote, written statement made by a Wilson to Dr. Webb in regard the "arms" that he [Wilson] fo when the remains were first ashore. "One arm was lying wes the body, 23 feet long; one stu of arm, west of the body ab three feet; three arms lying so of the body and from appear attached to same (although I not dig quite to body, as it laid down in the sand, and I was v tired), longest one measured o 32 feet, the other arms were 3 t feet shorter."

"Soon after this examinatio the footnote continues, "the sp men went adrift in another sev storm and was again cast ash further south, which will proba account for the loss of the suppo arms."

Nevertheless, Verrill conclud the statement regarding arms m have been erroneous. "Appare nothing that can be called stu of arms, or any other appenda were present." Again, Verrill scribed the tissue samples Webb had sent him, and rejec them as having come from a ce alopod.

In a letter to *Science*, Ver wrote of additional studies he made "which confirm the ceta affinities more definitely.

"The extreme firmness toughness of the thick ela masses of integument show that structure must have been inten for resistance to blows and to gr pressure, and could not have p tained to any part of an ani where mobility is necessary. T are composed of a complex strong *elastic* connective tissue bers, like those of cetaceans. Th are no *muscular* fibers present any of the parts sent. This lack muscular tissue and the resist nature of the integument are s ficient to show that the creat could not have been a cephalop for in that group a highly contractile muscular tissue is essential."

After considering the possibility that "the great bag-shaped mass represents nearly the whole upper part of the head of [a sperm whale] detached from the skull," Verrill concluded: "Therefore, a view that it may be from an abnormal or normal sperm whale must be regarded as a supposition or theory that still needs more evidence to support it, but is at present the most plausible."

A letter immediately following Verrill's in the same issue of *Science* expressed the views of F. A. Lucas who, I learned later, was curator of comparative anatomy at the U. S. National Museum. Lucas thought that Professor Verrill would have been justified in making a much more emphatic statement (in his earlier note in *Science*), than that the masses of integument from the "Florida monster" resembled blubber. "The substance looks like blubber, and smells like blubber and it is blubber, nothing more nor less," Lucas concluded.

In the same year (1962) that I ordered photocopies of the publications just quoted, I sought further information about the preserved tissue labeled *Octopus giganteus* Verrill that Voss had remembered seeing in the collection of the Smithsonian Institution. My next letter was to the curator of mollusks at the Smithsonian, Harold A. Rehder. In his absence the associate curator replied to my inquiry, confirming that the museum did indeed have such a specimen. Since it was the basis for the scientific name *Octopus giganteus*, which Verrill had proposed, he said it was the scientific responsibility of the museum to keep the material for any and all future reference, even if it was not a piece of giant cephalopod.

Museum curators guard their specimens zealously, and it appeared that this one was not available for further examination, at least, not any examination that would endanger it.

When Rehder returned and saw my letter, however, he was able to provide other material that far exceeded my expectations. Moreover, he later permitted a friend, Joseph F. Gennaro, Jr., then of the Univer-

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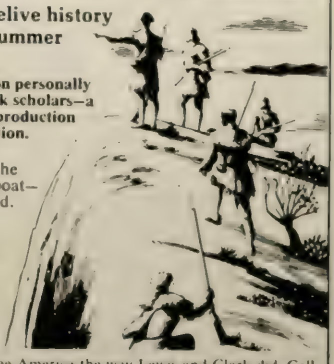

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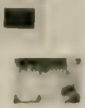

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sity of Florida, to carry away sample of the tissue for histologica examination. Gennaro had been working on the common Atlantic octopus at the Marineland Laboratory. When he heard my account of the St. Augustine Beach sea monster his interest was aroused, and he persuaded Rehder to part with a small piece of *Octopus giganteus.*

Along with the sample of tissue Rehder provided us with the photograph that accompanies this article a photograph made from an original glass plate that Dr. Webb o an assistant had exposed more than 60 years before. Also, he later sen me photocopies of Dr. Webb's correspondence with W. H. Dall, the former curator of mollusks at the National Museum.

In one letter dated January 17 1897, Dr. Webb wrote: "Yesterday I took four horses, six men, three sets of tackle, a lot of heavy planking, and a rigger to superintend the work and succeeded in rolling the Invertebrate out of the pit and placing it about 40 feet higher up on the beach where it now rests on the flooring of heavy plank."

The next day he wrote again, "I think I made one mistake in my description. The external muscular layer is circular and the internal longitudinal. I was obliged to go down in hot haste this morning to make a legal claim of it as one of the men who go about giving shows was going down and have it cut up and bring it up as a show. I went down and staked it around and put ropes around it and put up a notice that it was in my possession so that I do not think there will be any more trouble."

On February 5, Dr. Webb wrote: "I made another excursion to the invertebrate and brought away specimens for you and for Prof. Verrill of Yale. I cut two (2) pieces of the mantle and two (2) pieces from the body and put them in a solution of formalin for a few days before I sent them to you. Although strange as it may seem to you I could have packed them in salt and sent them to you at once although the creature has been lying on the shore for more than two months. And I think that both yourself and Prof. Verrill, while not doubting my measurements, have thought my account of the thickness of the muscular, or rather tendonous husk pretty large so I am glad to send you the specimens and will express them packed in salt in a few days."

Following other brief letters concerning the shipment of the specimens (and the expense of the formalin required), he wrote on March 17: "As you already know Prof. Verrill now says our strange creature cannot be a cephalopod and that he cannot say to what animal it belongs. I do not see how it can be any part of a cetacean as Prof. V. says you suggest. It is simply a great bag and I do not see how it could have been any part of a whale." And, at the end, "What can I purchase the Formaldehyde for by the dozen?"

In a long, undated letter, Dr. Webb wrote of moving the creature or further examination. "We could vith a dozen men pulling at the opes only partly raise it as you vill see. I have another scheme vhich I hope to accomplish if I can aise the funds and that is to draw t by means of a windlass farther ip the bank entirely out of the pit o that the hood can be spread out, nd then I hope to be able to get nen to cut through the enormously hick hide which measures in some laces 3½ inches in thickness, and o open the whole thing up. The ood is so tough that when it is exosed to the air an axe makes very ittle impression on it. Judging rom the difficulty of moving it, it aust weigh 6 or 7 tons for 12 men ith a block and tackle ought to ove anything less.

"After getting it out we found it n being straightened out to meaure 21 feet instead of 18 as I first eported to you. A good part of the antle or head remains attached ear to the more slender part of the ody. This was spread out as much s possible. The slender part of the ody was entirely empty of internal rgans. And the organs of the remainder were not large and did not ook as if the animal had been so ng dead as it appeared to have een when first washed ashore some ix weeks since. The muscular coat vhich seems to be about all there is f the invertebrate is from 2 and 3 o 6 inches in thickness. The fibers f the external coat are longitudinal

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and the inner transverse. There was no caudal fin or any appearance as if there had been any. There was no pen to be found nor any evidence of any bony structure whatever. It is still in a comparatively good state of preservation and so would it not be a good thing for yourself or Prof. Verrill of Yale or both of you to come down and examine it for yourselves and so determine its exact place better than I can? If you think of coming at all you ought to come at once. I have written a similar letter to Prof. Verrill. You see I said invertebrate rather than squid . . . that is certainly safe."

Dr. Webb's practice and pocketbook must have suffered during this period, and his request that Professors Dall and Verrill come to Florida and see the monster with their own eyes was to no avail. The last letter in the collection is a melancholy one. Written by Professor True, Dall's superior at the National Museum, it read:

"Dear Mr. Dall:

I am sorry to say that the secretary does not see his way clear have the cuttlefish examined at cost of the Institution and the M seum can scarcely afford the pense at this time.

Could not measurements, etc., made by Dr. Webb and some spe mens saved?

Yours.
F. W. True"

And so, apparently, ended saga of the St. Augustine Beach monster. There seems to be record of its ultimate fate.

PART 2

The Creature Revealed
by Joseph F. Gennaro, Jr.

The people in the Smithsonian Institution's Hall of Mollusks had everything ready when I arrived to take specimens of the sea monster. As we approached the hall room where the sample was, I was a little surprised at their suggestion that I remove my coat, jacket, and shirt. I soon realized why: the smell in the room was very strong and became even stronger as we approached a stainless steel sink in a far corner.

There by the sink was a glass container about the size of a milk can. Inside it was a murky mixture of cheesecloth, formalin (and I think some alcohol), and half a dozen large white masses of tough fibrous material, each about as large as a good-sized roast. We lifted them up with the cheesecloth, then took them out with forceps.

The pieces corresponded closely to Webb's description. There was very little fat or oil in them; they were almost as white as soap. I cut the samples I wanted with a pathologist's knife, which uses replaceable blades: the connective tissue was so tough that it dulled four blades simply to cut one or two finger-sized pieces. I wrapped these in cheesecloth and put them in a tightly covered jar together with some of the fluid. (The Smithsonian's jar was lost during a move; the samples I had taken are all that is left of *Octopus giganteus* Verrill.)

Unfortunately, there were no distinguishing structures in the pieces I dissected. No suckers, identifiable skin structures, or even muscular masses were discernible. All the pieces had the same homogenous, tough, white, fibrous texture. Only from one piece was I able to carve a small specimen from what appeared to be the periphery of the animal. I judged this by what looked like "natural" smoothness on one margin of the piece, perhaps indicating an original surface, although I had no way of knowing whether it was an outer or inner surface. Certainly, there was none of the typical covering layer one could expect from either a mollusk or mammal.

In my laboratory, I prepared the specimens for histological analysis together with "control" specimens of contemporary squid and octopus. When the slides were ready, I eagerly turned to the microscope to observe for myself the structure of this peculiar sea beast. Would the cells be the highly differentiated cells typical of a mammal, indicating that despite the lack of or blubbery smell the piece h really come from some type whale? Would the architecture similar to the squid sample or that of the octopus that I had comparison?

To my great dismay, no cellu material at all was discernible. P haps because the tissue mass h lain for so many days on the bea of St. Augustine, or perhaps cause the formaldehyde or alcol had had insufficient time to pe trate for adequate preservati nothing of the original cellular chitecture remained. I found, ho ever, that my control sampl which had been properly prepai for histological analysis, also fail to show much cellular arrangeme But even more striking than the sence of cellular structure was presence of distinctive patterns connective tissue. Differences tween contemporary octopus a squid tissue struck the eye imn diately, and each was obviously d ferent from the typical pattern mammalian tissue.

It occurred to me that I st might learn something by observi and comparing the connective t

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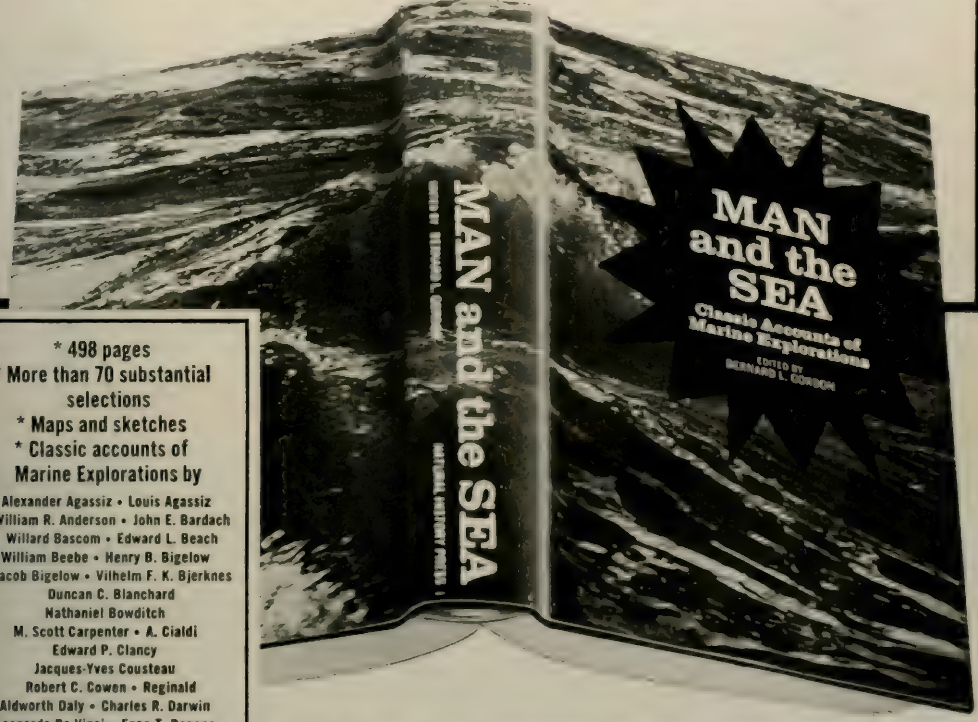

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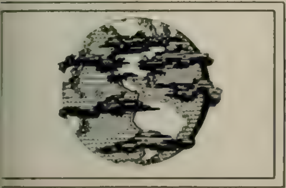

ars are part of the problem, but not the *whole* problem

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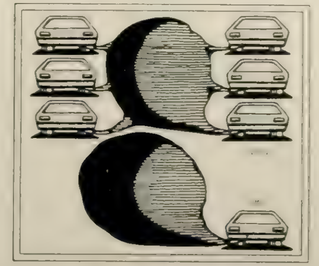

Today's car isn't the polluter its ancestor was.

The nagging problem, however, is getting rid of the nitrogen oxides. It's going to require control— not just of car exhausts—but of many sources of combustion as well. By 1973, Ford engineers plan to have our share of the problem cut in half. And by 1976, even greater reduction will be required.

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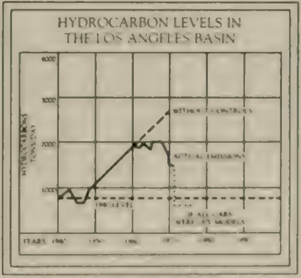

The battle against pollution is being won because we didn't start fighting it yesterday.

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THE CLUTCH OF THE FALCONER

Turning a bird of prey into a bird of play

by Dean Amadon

"Falconry, Sport of Kings" is the title of an article published by *National Geographic* 50 years ago, and still in great demand because it was written and, even more important, it was illustrated by Louis Agassiz Fuertes, America's greatest painter of birds since Audubon. Now that falcons are becoming as scarce as kings, what should our attitude be toward this ancient sport, which remains as appealing as ever and continues to attract new devotees?

The question is raised again by the recent publication of several authoritative, finely illustrated books about falconry. The author of *A Falcon in the Field*, J. G. Mavrogordato, is a retired British lawyer of the colonial service. Stationed at various times in the Sudan and Middle East, he has pursued his hobby in the company of some of its oldest practitioners, Arabian sheikhs. The coauthor of *American Hawking*, Prof. E. W. Jameson, Jr., of the University of California at Davis, has likewise followed falconry as a hobby for all of his adult life. With his Japanese wife he produced an earlier, elite work, *The Hawking in Japan*. For years his prized possession was an ornate hawk-eagle taken from the jungles of tropical America. The bird
showed no reluctance at exercisi
its hunting skills on Californ
jackrabbits. These books permit t
vicarious pursuit of falconry, b
at the same time they excite an a
tive interest in the sport that may
fatal to falcons.

Falconers are interested in t
welfare, present and future, of f
cons, more so than most peop
Big game hunters are likewise inte
ested in a continuing supply
trophies, yet this does not me
that some species would not
hunted out of existence if stringe
protective laws were not enact
and enforced. When the ratio
alization is used: "If I don't sho
this animal or take this falco
somebody else will," an animal c
be driven to extinction by
friends.

But despite falconers, egg coll
tors, and the hunters and farme
who shot every bird of prey th
saw, falcons persisted in the pa
The most prized of them all, t
peregrine falcon, nested along t
Palisades of the Hudson Riv
within a few miles of New Yo
City. In the winter some of the
even moved to the city, perchi
and roosting on skyscraper ledg
feeding on street pigeons. An occ
sional pair became so fond of t

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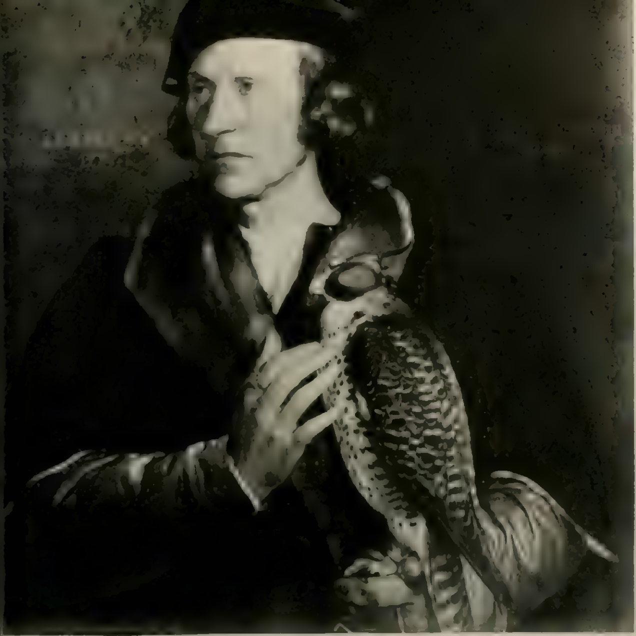

Robert Cheseman, falconer of Henry VIII of England.
Painted by Hans Holbein, the younger, 1533.

n life that they attempted to nest a building ledge.

In the mid-1940's the peregrine lcon, along with other birds of ey and fish-eating birds, declined astically in America and else-iere. Today there is not a single -ting pair of this falcon in the stern United States and only a re handful in the west. The pere-ine has been placed on the list of reatened species.

What happened in the last two or ree decades to deal such a blow to regrine falcons, bald eagles, and preys?

At the beginning of that period, I s with the Army Sanitary Corps Hawaii during World War II. I call the advent of DDT, the chem-l that was to revolutionize pest ntrol. Admittedly it did wipe out bedbugs hitherto ensconced in rickety old wooden building in nolulu where we were quartered. t none of us, as we sloshed und in the oil emulsion of DDT, en drenched to the skin, had any son to suspect that the wonder emical might be harmful to birds, h even to ourselves.

Although falcons began to de-ease as soon as DDT came into neral use after the war, it was 20 ars before it was proved that this chemical and other chlorinated hydrocarbons were the cause of the decline. Even when not ingested in sufficient dosage to kill a falcon (or eagle or pelican), these substances upset the bird's calcium chemistry, making its eggshells so thin that they collapse before they can hatch.

Falcons, like other predators, are most apt to catch a bird that is a little slower than its fellows; often that is the individual with an overdose of DDT. Thus the falcon, or other predator at the top of the "food chain," usually gets an extra dose of pesticide. Whether the general danger of such chemicals will be recognized in time is debatable. In the British Isles, where DDT has been largely banned, there is evidence of a slight upward trend in falcons. In North America and elsewhere, the picture is grimmer.

The bearing of all this upon falconry is fairly obvious.

The decline in falcons comes at a time when interest in falconry is increasing, partly as a result of greater exposure through the mass media. Disney's film on the peregrine ends on a fine note with the falconer releasing his bird to aid in the propagation of the species. But many young people, seeing the film, will be impelled to have a try at the

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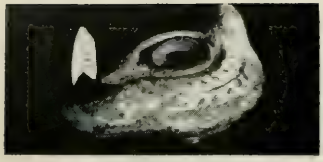

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sport. Even more than fishing, hunting, or boating, falconry demands that the participant turn his back on crowds, towns, and cities, and indeed roads. Since an increasing number of people are attempting to flee these very things, temporarily or permanently, it is small wonder that falconry is so popular. Some condemn the sport as cruel, but it is less so than conventional hunting or fishing, not to mention some of the treatment man reserves for his own species. But whatever the answer or justification, the net result of an awakened interest in falconry is to put destructive pressure on the already dwindling stocks of falcons.

The problem is not easily localized in this day of rapid transportation. An American oilman who recently traveled on an Arabian airline related that, when he glanced up to avoid staring at a pair of well-turned ankles emerging from a fully robed figure, he saw a couple of trussed, live falcons in the luggage rack. And indeed, petroleum-opulent sheikhs have placed standing orders for gyrfalcons, and probably peregrines as well, at $1,000 to $2,000 apiece. What sourdough, trying to turn a dollar, can resist such temptation?

In most parts of the United States or western Europe the practice of falconry presents many built-in difficulties. But there are those who persist, and among them are a few whose urge to obtain falcons borders on mania. An otherwise respectable educator, since deceased, told me years ago how he risked life, limb, and reputation to raid one of the few then remaining peregrine aeries, on Mount Tom in Massachusetts, which happened to be a state park as well.

The same individual later hastily resigned from the local natural history society, after it was revealed that he had hired some teenage boys to risk their necks trying to obtain falcons for him along the Palisades of the Hudson.

Not all falconers are similarly fanatic, but there are overenthusiasts. The resulting demand for falcons can quickly become intolerable, now that the birds have been so severely decimated by other factors as well. As noted, the problem is augmented by air transport and by unlicensed and ignorant dealers, ranging from nationally kno stores to roadside zoos, who tempt to cash in on the craze f pets and wild birds. Legislation clearly needed, but unfortunate the problem is international scope and includes many forms wildlife and even certain plants—n merely falcons.

One possible solution would be breed falcons in captivity, for stocking after the pesticide level h abated and also for use in falconr The little sparrow hawk, or Ame can kestrel, is now being reared flight cages with relative ease a in some numbers. Obviously t peregrine represents a more di cult proposition than its small grasshopper-eating cousin. Still, has been bred once or twice. Se eral all-out efforts are now bei made, one with the official backi of the Canadian Fish and Wildl Service.

Meanwhile, I am afraid falcon should be content (and indeed quired) to use less desirable l nevertheless spirited hunters su as the red-tailed hawk. Even th care is needed. All too often amateur falconer lacks the time, p tience, and space to train his bi properly or even to care for Many such birds die, others fi their way to zoos, still others a released but are too tame or we to survive.

Even the best trained and car for falcons are lost from time time. They may, for example, fail catch the intended game and ch it "right out of the country." E cumbered as they often are straps ("jesses") and bells, ove tame, lost hawks are often killed b fore they can be retrieved.

And finally, the glamor of f conry attracts many individuals, pecially boys, whose enthusia soon wanes. Perhaps they should made to read T. H. White's T *Goshawk*, to learn that training hawk or falcon requires hour af hour of patient effort. Even th the bird is sometimes lost duri the first flight for game.

Falconers should be licensed a recruits required to have traini under one versed in the sport. Th administered, falconers might come (as some already are) lead of the move to protect birds prey—those splendid symbols untamed nature.

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The last survivor of pre-European times
on Tierra del Fuego saw her culture disappear
ever. She even lost her Indian name, and was
known only by her Spanish one

LOLA

by Anne M. Chapman

\t the end of the winter of 1966
Tierra del Fuego, an Indian
man named Kiepja died in a
ernment hospital, not far from
ere she had been born 90 years
lier in a tent made of guanaco
n. Of the then ten surviving
k'nam (Onas), she was the only
who had actually lived as an
ian. She had witnessed the end
a culture that had existed "since
beginning of time," that of a
historic people who lived solely
hunting, gathering, and fishing.
Vhen Isla Grande (the largest in
Tierra del Fuego archipelago,
t south of the Strait of Magel-
was first settled by Europeans
about 1870, the Indians, mainly
k'nam, were still independent
only slightly affected by the
radic contacts they had had with
opeans since the sixteenth cen-
. Their population was then
ut 3,500, certainly no more than
)0. During the following decades
st of the Selk'nam were slaugh-
d or died from diseases and
er results of the usurpation of
r land. In 1919 Father Martin
inde counted 279 Selk'nam. Ten
rs later fewer than 100 re-
ined. By 1966, there were only
it, including four whose fathers
e of European descent. All were
r the age of 50 and had been
n shortly before or after the
riginal culture had been shat-
d. All but one, Kiepja, spoke
nish fluently; several also spoke
e Selk'nam. But Kiepja, who
also called Lola, spoke her own
guage fluently and only some
nish. She had remained psy-
logically and emotionally iden-
d with her culture; moreover,
was a shaman and thus pos-
sed a profound knowledge of its mystical traditions. She was happy recalling the ancient way of life, but it saddened her all the more when she realized that nearly everyone had died, that her world had disappeared forever.

Despite her tragic life, she laughed easily and joked about herself and others. Sometimes she would call me her daughter; other times, when I would tie her apron for her, she would look over her shoulder at me and laugh while rocking from one foot to the other, saying *ala ala*, meaning that I was treating her like a baby.

I first met Lola during my Christmas vacation in 1964. At the time, I was working with a French archeological mission on the Chilean side of the island, and Lola was living on the reservation located near Lake Fagnano on the Argentinian side. As an ethnologist, I hoped to be able to work with her, and was relieved to discover that contact was easy. On my first visit, she sang a chant mourning the death of her mother. I returned the following day with a tape recorder and spent the next three weeks with Lola and her friend Angela Louij, also a Selk'nam. With Angela's help as an interpreter, I found that Lola had a great fund of knowledge concerning her culture. I checked her memory by asking her the names of Indians mentioned by Lucas Bridges in *Uttermost Part of the Earth*, some of whom had died shortly after the turn of the century. Sometimes she replied that she did not know, but when she did give names, they were correct. During those weeks we recorded 38 chants. The recordings were technically deficient for a number of reasons, but as I was committed that year to other field work, I was obliged to leave.

I came back to Paris at the end of 1965 and played the tapes for Gilbert Rouget, the head of the ethnomusicology department at the Musée de l'homme. He suggested that I return to Tierra del Fuego to rerecord what I had brought and if possible, to record other chants. Also Claude Lévi-Strauss believed that this might be the last opportunity to obtain new data concerning a group that, for decades, had been considered extinct.

Only two collections of recordings of this group existed, and both had been made on cylinders. The first dated from 1907-08; the other was made in 1923-24. In January, 1966, we felt that this might be the last chance to accurately record authentic chants of this culture.

In March, 1966, I returned to Tierra del Fuego for a 3-month stay. This time the main problem was the language barrier. Although adequate for her everyday needs, Lola's Spanish was rudimentary. While speaking it, she gave the impression of an almost childlike mentality, thus concealing her passionate temperament and complex nature, her bewilderment and profound sorrow. Her world had slowly sunk into nonexistence as those around her had died strange deaths, and gradually she interiorized all the realities of her existence, while to strangers she became *la reliquia* ("the relic").

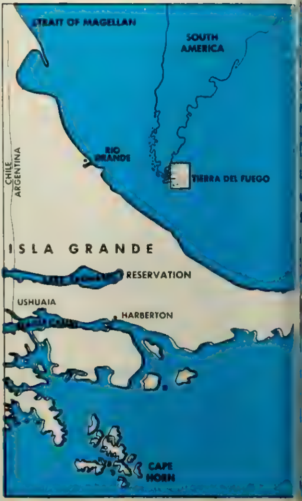
The only place I could work with Lola was on the reservation and given the situation there, it was not possible to bring another Indian who might have acted as an interpreter. It was difficult for me to learn Selk'nam, partly because Lola could only translate isolated words. Moreover, Selk'nam is a tonal and glottal-stop language. Often when I was endeavoring to pronounce a word, Lola would frown, looking intently at my mouth, her lips moving soundlessly, and when my version finally came out, she would sigh in relief and laugh, saying *eso es* ("that's it"), as if we had won a battle against great odds.

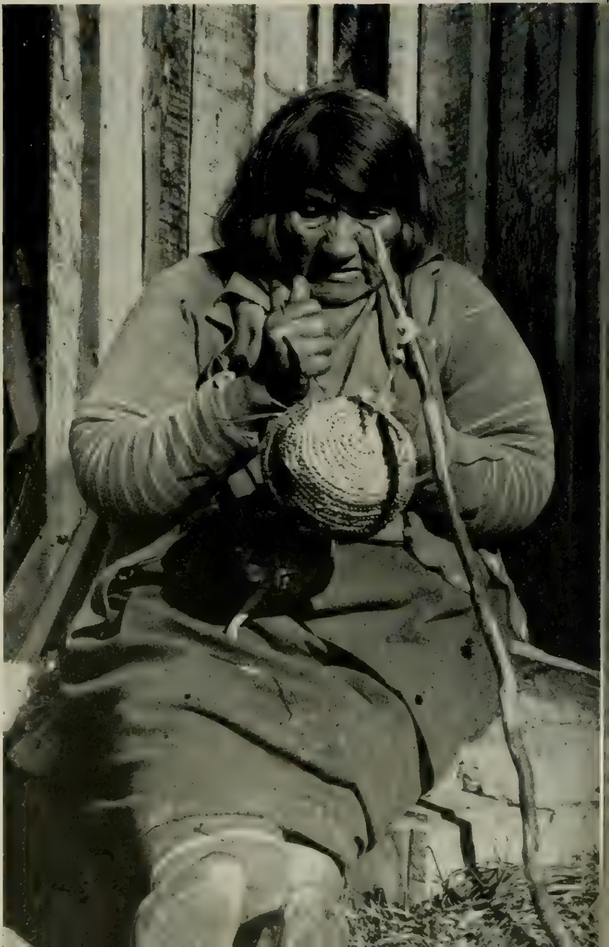
From March to June I lived mostly on the reservation, on a sheep ranch a few steps from Lola's hut where Luis Garibaldi Honte, a relatively well-to-do and acculturated Indian, kindly let me stay. He had instructed his employee to supply Lola with lamb meat and other necessities. Don Luis had taken care of her on several occasions when she had been ill. He and his family were not there much of the time during winter, however, as they preferred to remain in Río Grande, so the only other person on the ranch, besides Lola and myself, was a *puestero* ("mounted shepherd"). Every week or two, I would go to Río Grande for several days to study my material and to purchase supplies. I did not want Lola to become too accustomed to my company lest she feel all the more lonely after my departure.

She had had twelve children, seven with her Indian husband, and after his death, five more from her union with a Chilean. They had all died, most of them as adults. Her grandchildren, excepting one who lived on the continent, had also died. She had one living descendant, a great-grandson, who had been adopted by the Garibaldis.

Until she was about twenty-five years old, Lola had had little contact with Europeans. Then, in about 1900, her husband went to work at Harberton, a sheep farm on the south coast of the island. Harberton was founded by an English missionary, Thomas Bridges, one of the first white settlers in Tierra del Fuego and virtually the only one who consistently befriended the Selk'nam. But even then, at the beginning of this century, and for several decades afterward, Lola and her family, like the other Indians, would revert to their nomadic life in the winter, principally to hunt guanaco. The great ceremony called *hain* (which included rites of initiation for the boys, the *kloketen*) continued to be held sporadically and Lola often participated.

During these years her mother and her maternal uncles trained her to become a shaman, a *xoon*. One





Lola never saw the mainland; on Isla Grande, her whole world, she kept busy weaving baskets, splitting wood, carrying water, and cooking.

ight, sometime during the year)26, she dreamed that the spirit of ne of her deceased shaman uncles sited her and transmitted his ›wer to her by means of his chant. is spirit had flown over Lake Fag- ıno (called Kami by the Indians) eking her. This uncle had died on e opposite side of the lake from here she was then living. In her eam she heard his spirit singing: Where are you, my daughter?" hen she heard his call, she re- ated it, thus awakening herself. that precise moment, she said, s power penetrated her "like the tting edge of a knife." It was en that, in the traditional manner, e became a shaman.

When I met Lola she had been ing alone on the reservation for ıny years, most of the time in a ›oden hut. She cooked her meals, thered firewood, fetched water, d did other chores. She also wove skets, which she sometimes sold. e had owned some sheep and a v horses, inherited from some of r children and from other In- ıns. But she told me that all of r animals had been stolen, some two of the Indians and the rest other neighbors. But what she ssed most of all was a favorite se. Until about 1961, when she s already well over 80, she would e long rides to visit someone or buy *maté* ("herb tea") or food. t after she fell off the horse sev- l times, Don Luis thought it wise to allow her to ride. She never over what seemed to her a gross ont.

ola was aware that she was ch more Indian than the other viving Selk'nam. The difference ween her and the others was ac- tuated because she was a sha- n and was therefore deeply in- nced by the mystical and thological traditions of her cul- e. Although some of the other lians secretly admired her for shamanistic power, they had no gering fear of her since she was a full-fledged shaman. As was ally the case with a woman sha- n, she did not have the power to . Over the years she had treated w of the Indians and even some ites in shamanistic seances. But she did not always use her "power" when curing. Once when I was frying potatoes the grease splattered, burning my hand. Taking my hand in hers, she rubbed cold water on the burn with the palm of her hand. Then she blew on it for several minutes until the pain disappeared entirely. And when I complained of a backache she told me to lie face down on her bed. Then she pressed hard with the palms of her hands and blew with quick puffs on the aching part.

She had several friends among her people but did not see them too often. She knew that most of the non-Indians on the island had little or no respect for her. But she was very responsive to the few who liked her and joked with them in her broken Spanish. Occasionally tourists would come to the reservation where she lived, and invariably, they wanted to photograph her. Flanked by several strangers she would stand rigid, scowling into the camera. If not given anything for being thus bothered, she would become indignant. But she never showed her indignation to the tourists.

Twice in the last few years her huts had burned down. The memory of these fires terrified her, although she had not been burned. Her last hut had been built on the Garibaldi farm, close to the main house so that she would not be as isolated as she previously had been.

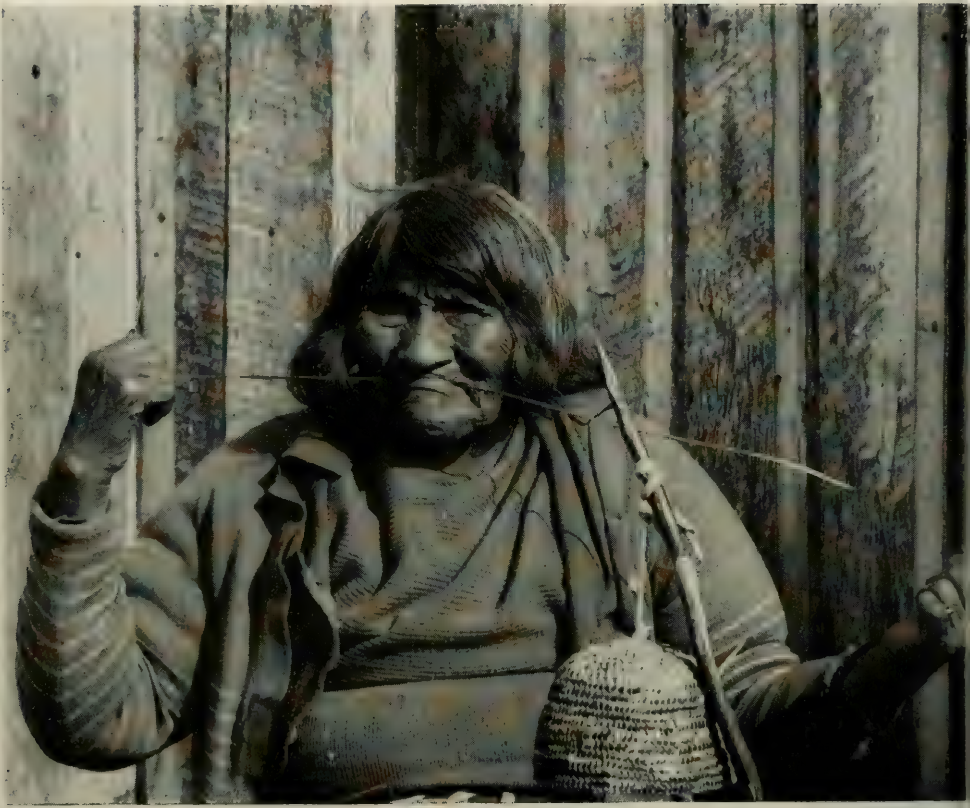
I was worried myself about Lola's hut burning down. As winter set in, in the last year of her life, we spent more and more time huddled over the stove. Often she would overload it and burning split logs would fall out. Exclaiming excitedly she would try to shove them back into the stove. Every night before I left I would say *hauk* ("fire") *chon* ("water"), reminding her to pour water over the stove before she went to bed.

Behind her hut there was a tepee-shaped, open-fronted structure made of logs over which rags were thrown. Here, weather permitting, she would build a fire and sit weaving a basket. She told me that when alone she would go there sometimes, just to sit by the fire. Perhaps she felt closer to her old way of life there.

She frequently proposed that we go to certain places many kilometers away. She was convinced she could walk greater distances than she actually could. But together we walked short distances to gather firewood or to visit places she had lived before or campsites of Indians she had known.

When rain threatened, she often went outside "to cut the sky," as she would say in Selk'nam, so that we might have good weather. One day when I called her attention to the cloudy sky, instead of taking her usual broomstick or walking stick to clear the sky, she took her meat knife, saying a knife was better. To insult the clouds, she sputtered, chanted, and shouted at them, while making large sweeping movements, usually with a stick. Her purpose was to push the clouds away toward the west, the sky of the rain. On a cloudy or rainy day she would clear the sky several times if necessary, until finally that day or the next, the sun would reappear. When the effect was not immediate she would sometimes laugh, saying that the clouds *no quieren*, meaning that they did not want to leave. Of course, when she insisted upon "cutting the sky" long enough, the clouds would leave. Clearing up the weather was one of the attributes of the shamans.

She was not very neat and would spit almost anyplace. She knew how to use a fork, but preferred to eat with her fingers. Although she detested the idea of taking a bath, upon arising she would wash her hands and face. She swept her hut when she knew I was coming, but I have the impression that when alone, she would not bother to do so very often. Without thinking, she would drop refuse on the floor or throw it out the door for the [illegible] She had the habit of piling [illegible]



pell-mell in the corners of her hut and on her bed. It followed that she spent a great deal of time searching for lost articles, particularly her meat knife. These habits were largely culturally determined. She had been brought up to live as a nomad, to change campsites every few days, to dress in guanaco skins, to clean herself with dry clay or moss, and to possess only the necessities for existence, no more.

In her later years she was given many useless things, particularly an excess of old clothing. She had a favorite man's suit jacket, a hand-me-down from years before. As she had other, less ragged jackets, I asked her why she was fond of it. "For the pockets," she replied. It had ten pockets, inside and out. This pleased her a great deal as she liked to carry the little money she had with her. She was wary of being robbed, and although at times money had been taken from her, more often she simply forgot where she had hidden the missing money. This suspicion of being robbed was, I believe, more a symptom of senility or insecurity than a cultural trait.

While Lola was not concerned about the appearance of what she wore, she was sensitive to the beauty of her face. Sometimes when I would comb her hair, she would look in the mirror laughing, saying *yo olichen* ("I pretty") or frown and say *yippen, yo vieja* ("ugly, I old").

Although she ate lamb three or four times a day with remarkable appetite, Lola would often ask if I could bring her fish and guanaco meat. I was never able to get either.

There were two other items she
ways asked me to buy when I w
to Río Grande—butter and sw
vermouth. She ate butter as if
were candy, and would have c
sumed half a pound a day if I h
not discouraged her. And each d
we invariably had an aperitif
fore lunch. Several times she
sisted that I bring her two or th
bottles together. Finally I compli
When I next left for Río Gra
she still had two bottles. I began
worry, imagining she might dri
too much, although so far as
knew, she never had. When up
returning I inquired, she repl
that she had not touched either
them, that she was waiting for
A few times while I was away,
walked out to the side of the r
to wait for me, even though
knew I was not due that day. W

sked her why, she said that she
nply wanted to wait for me there. She delighted to sing for the tape
order, *la máquina*, "the ma-
ne," as she called it. One of the
ints we especially liked con-
rned an old guanaco and was a
ant of mourning as well as one of
hain.

"Ra ra ra ra ra," Lola would sing,
itating the old guanaco.

The text of this chant is a myth.
allegory of the prohibition of in-
t. The story belongs to *lyluka*,
mythological past, and is about
nan who schemed to make love to
daughters. As he was about to
ceed, however, he and his
ighters were transformed into
anacos. Lola once sang it with
se words in Selk'nam:

"The old guanaco (when he was
l a man) said to his daughters:
am about to die. Bury me in the
ite earth but do not bury me
p in the earth, leave my head
l shoulders free. After I die you
l perform *tachira* [mourning
s] and as you are going away singing of your grief, a man will approach you. He will look exactly like me but he will not be me. He will ask to make love to you. Do as he says.'

"And when he died the daughters did just as their father had ordered. As they walked away, while they were still singing the chant of death, the old guanaco [now metamorphosed] jumped out of his grave, hot with desire to make love to his daughters. He sniffed their tracks and chased wildly after them, urinating as he ran. When he caught up to them he said: 'I am the one your father told you about. Come let us make love.' One of his daughters ran on. When he made love to the other she, too, became a guanaco."

Lola would invariably insist that I immediately play back the tape when she had stopped singing. While listening she would most often laugh, appear very pleased, and comment *olichen* ("lovely"). But sometimes she would say *yippen* ("ugly"), scowl, and looking worried, say that she wanted to record the same chant again, right away. Often she asked that the tapes be replayed for the pure pleasure of hearing herself again. She sang some of the chants again and again, particularly two of the mourning chants. One of these she had sung upon the death of her mother and the other when her last two sons had died. She sang these so frequently that sometimes I would not record them, especially during the last few weeks when I was low on tapes and when it was so cold that the batteries had to be taken out of the recorder every minute or so to be heated on the stove. But she wanted to be recorded each time she sang, and when I did not do so she was displeased. I tried to explain that I could not record the same chant indefinitely. She did understand, however, that I wanted to record the greatest variety of songs possible.

Quite often when I greeted her in the morning, she would smile widely, saying, "I found another," meaning that during the night she had recalled the chant of a certain person, which she had heard perhaps 50 years earlier. She would ask me excitedly to hurry, as if she were holding a hot potato, and get the machine ready lest the chant disappear from her memory before we could record it. Once recorded, I often played it back to her, then asked her to sing the same chant again, to get the best possible rendition. She did not always comply with my request. There were times she preferred to sing another chant, and some chants she did not like at all. Once in a while she became irritated at my insistence, but in the end, she would usually laugh and ask me why I wanted to record it in view of the fact that it was so ugly. At other times, however, she seemed to understand that her voice was being recorded to preserve the chants. Of the 92 chants we recorded in 1966, 38 had been recorded the year before. The rest she recalled gradually as we worked together in the last few months of her life.

She made me promise never to play the tapes for anyone on the island except Angela and one other friend. In 1965, during the three weeks we recorded, whenever anyone approached the house she became nervous and asked me to hide the recorder. The following year we had very few [illegible]

**metimes Lola sold the
skets she wove. One went
Claude Levi-Strauss.**

seemed less timid. She explained to me that the "others" (the whites as well as some of the other Indians) would laugh if they heard her singing, that they did not understand. Once in a while she said that she was recording for the Indians to the north.

In addition to recording chants, we recorded some basic vocabulary (which bored her), proper names, place names, and kin terms. At times she seemed to be secretly amused at me, as when, for instance, I recorded her imitations of birds. These interested me because many of the names of birds are onomatopoetic. What she really enjoyed, however, were the chants. When singing those of the *hain* she would pantomine the dance steps and gestures of the spirit (always a man disguised with a mask and body paint) to whom the chant was being sung and especially of a spirit called Shorti, who during the ceremony frightened the women by chasing them and throwing things at them. Sometimes, while imitating his short, rhythmic step, she would stab me gently in the ribs with her cane, saying in a half-joking, half-serious tone:

"Shorti was very mean to the women."

When telling me about certain of these spirits and the pranks the Indians played on one another during the ceremony, she would laugh until tears came to her eyes and then look at me still laughing and say *que salvajes* ("what savages").

A favorite account was one her maternal grandfather had told her mother. It concerned two *xoon* ("shamans") who were great liars. It all happened on the east coast of the island, near Cabo de Penas. It was a very cold winter and everyone was hungry. The two impostors, Koin-xoon and Hewiu-xoon, pretended they were *ochen-maten* (a *xoon* alleged to have sufficient shamanistic power to kill a whale and bring it ashore). That day no one went out to hunt, as everyone expected a whale to arrive any minute. They all stood along the beach shivering. The two impostors pointed to the sea, saying they saw a flock of gulls, a sure sign that a whale was nearing. They then sang the chant of the whale while jumping all about, making believe they were tugging a cord, dragging the tremendous whale ashore. All the others were anxiously waiting to eat the fat of the whale. But it was all a great lie. There was no whale at all. The *xoon* were making fools of everyone. The brother of Koin-xoon finally became angry and said:

"Here I am wasting my time. I am hungry but instead of hunting with my *teix* [a snare used to trap certain birds], here I am hanging around the beach all because of these liars."

During my stay the first year, Angela sometimes pretended she was tugging the invisible cord and Lola would become nearly helpless with laughter.

Ancient territory of the Selk'nam Indians stretches north of Lake Fagnano. A hotel now overlooks the hunting grounds of Lola's grandfather. Today, many of the Indians' descendants work as sheepherders.

Speaking her own language, Lola would repeat conversations heard more than half a century before. Toward the end of my stay she thought I understood a great deal more of her language than was the case. I endeavored to grasp at least enough to make a few short comments so that she would continue talking. One of the words she repeated most often was *koliot,* "red cape," the name given to the first intruding whites, apparently after the flannel capes worn by the first policemen to arrive. This was a warning of attack. An Indian would shout it when he sighted an armed rider on the horizon; then the entire camp would scatter as well as it could. She remembered the victims of the professional killers, several of whom had been hired by one of the first European sheepmen, José Menéndez. "Bad Christians—to kill the Indians," she would say.

She spoke time and again of her maternal grandfather, Alakin, who was renowned on the island as a great prophet. Other Indians confirmed that Alakin was not feared as were most of the shamans; rather, he was most highly esteemed because of his knowledge of the legendary past and what was considered to be his ability to predict the future by means of visions. He had been killed when quite an old man, along with two of his brothers, in retaliation for having stolen metal tools from the shack of some newcomers.

Referring to an epidemic of the later decades, she said:

"Dead—dead—dead. How [illegible]

dead? Look at the cemetery—it is full. So many died, every day. Trucks would go by full of the dead. They all died of *koliot* sickness—babies with their mothers, young girls not yet married."

As if it had happened the day before, she described how certain men had been wounded or killed during the last wars (really skirmishes lasting a few hours) between the Indians.

She spoke often of a war in which she had participated and which provoked the very last war among the Selk'nam a few years after the turn of the century.

She was a short distance from the camp when the enemy attacked. As the dogs with her began to bark, she ran back to the camp and there she saw her husband, Anik, wounded in the temple by an arrow. *Pobrecito* ("the poor fellow"), she would comment, "his face got all swollen." Then a certain Asherton tried to abduct her. She resisted and tried to escape. He became furious and ran after her, arrow in hand, shouting: "I'll kill you if you don't come with me!" Anik was about to be finished off when his cousin Pachek, on the enemy side, intervened, shouting: "Don't kill him! He's my cousin." Pachek also saved her from being abducted.

This battle took place on the east coast, near the Irigoyen River. Kinsmen and others, about 26 adults, were celebrating a *hain*, during which two youths were being initiated. The party was attacked by some 30 men from five different territories who were determined to revenge the death of a certain Uenxoon, shaman and champion hunter. He had been killed by an arrow from one of Lola's party, her uncle Tael. He and his son and one of Lola's brothers were among the six killed during this battle. Eight women were abducted by the enemy, but five escaped afterward and returned to their group.

The brutality of certain Indians had impressed Lola greatly, especially the action of one who, in a rage, had dragged his wife over the fire, severely burning her sexual organs.

She had great admiration for certain shamans, particularly for Maiich, who several times had performed the most difficult of all *xoon* ordeals, or "tests," as a demonstration of his power. He would insert a wooden-tipped arrow under the skin just below the collarbone and somehow pull it diagonally across his chest, withdrawing it at his waist. She would make grimaces of terrible pain while telling about it. She often sang the chant he had sung while performing, and once she repeated some of his words:

"My body is in darkness. I am, myself, to pierce it with an arrow."

This was the time when he had not sufficiently "prepared" the "channel" through which the arrow was to pass. He bled afterward, which he would not have, had he been in complete control.

Once she became annoyed with me. I was showing her copies of the photographs that accompany Martin Gusinde's volume. Included among them are several of the "spirits" of the *hain*, actually men disguised by paint and masks. When she saw the first of these she pushed it aside, refused to look at the others, and scowling at me, said that *no es para los civilizados*, meaning whites should not have seen them.

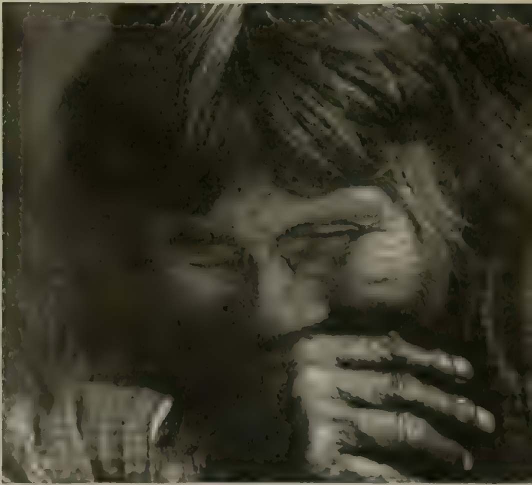
The last weeks before I was to leave I wanted to take her out for a ride. The administrator of a large hotel recently built on the edge of Lake Fagnano had shown sympathy for Lola so I told him of my wish. One day he came for us in his station wagon as he had promised. Lola dressed up in her new clothes and took all of her money with her for fear that her hut might be robbed during her absence, which was very unlikely. We spent two days and a night in the luxurious hotel where, as winter was nearing, we were the only guests. Before each meal the administrator asked Lola what she would most like to eat. She invariably replied—fis She sat for hours in front of th large fireplace chatting with u with the men who were working i the hotel, and with occasional neig bors who passed by. From the in mense dining room, which ove looked the lake, she pointed out th hunting grounds of her gran father, Alakin.

As the date of my departure dre near, she began asking me when was to return. I told her I woul come the following year if I coul manage it. From what I tried to e plain to her she surmised that lived on a big sheep farm ne Buenos Aires and that my *patró* had sent me to record her voice b cause he knew a great deal abo the Indians and liked them. Sh had never left the island and onl knew that beyond there was a "bi town" called Buenos Aires. She in quired time and again about m *patrón*, asking if I were sure that h would send me back again. Th more she inquired, the more I rea sured her that I would return. M *patrón* became "our" *patrón*. O the day of my departure she gav me a basket she had recently fi ished. Previously I had offered t buy it from her, but she had alway refused to sell it, saying she ha promised it to someone else lon before I came. Now she put the ba ket in my hands, saying that I wa to give it to our *patrón*.

When I returned to Paris I gav it to Lévi-Strauss, telling him it wa from Lola. He put it carefully u der a glass in his office.

Lola refused to leave the reserva tion that winter. Because of her ag and failing health she had bee taken to Río Grande the year b fore. But there she had passed th days sitting near a stove, drowsin when she was not being scolded b the mistress of the house for bein sullen, lazy, and dirty. This winte she was determined to stay in th country, on the land she knew, an never again to leave. I tried to pe suade her to spend the winter wit a part-Indian woman, Enriqueta d Santin, who was very fond of he and who lived nearby. Lola refused The last time I went to see her took Angela Louij with me and sh

nained some ten days after my
parture. Then Lola was alone ex-
t for the daily visits of the *pues-*
o who brought her firewood, wa-
and meat. The winter of that
r, 1966, was unusually severe
h temperatures of 30 degrees be-
zero, and Lola was virtually
wed in from July until several
s before her death in October.
en she became ill, the *puestero*
nt on horseback to notify the
ral Police Officer at Lake Kami.
ng a tractor, they transported
to the main road, and from
re she was taken by car to Río
nde where she died in the gov-
ment hospital a few days later.
was the end of the winter in
rra del Fuego, October 9, 1966.



"She was happy
recalling the ancient
way of life, but it
saddened her all the
more when she realized
that nearly
everyone had died, that
her world had
disappeared forever."

CORAL

by Frederick M. Bayer

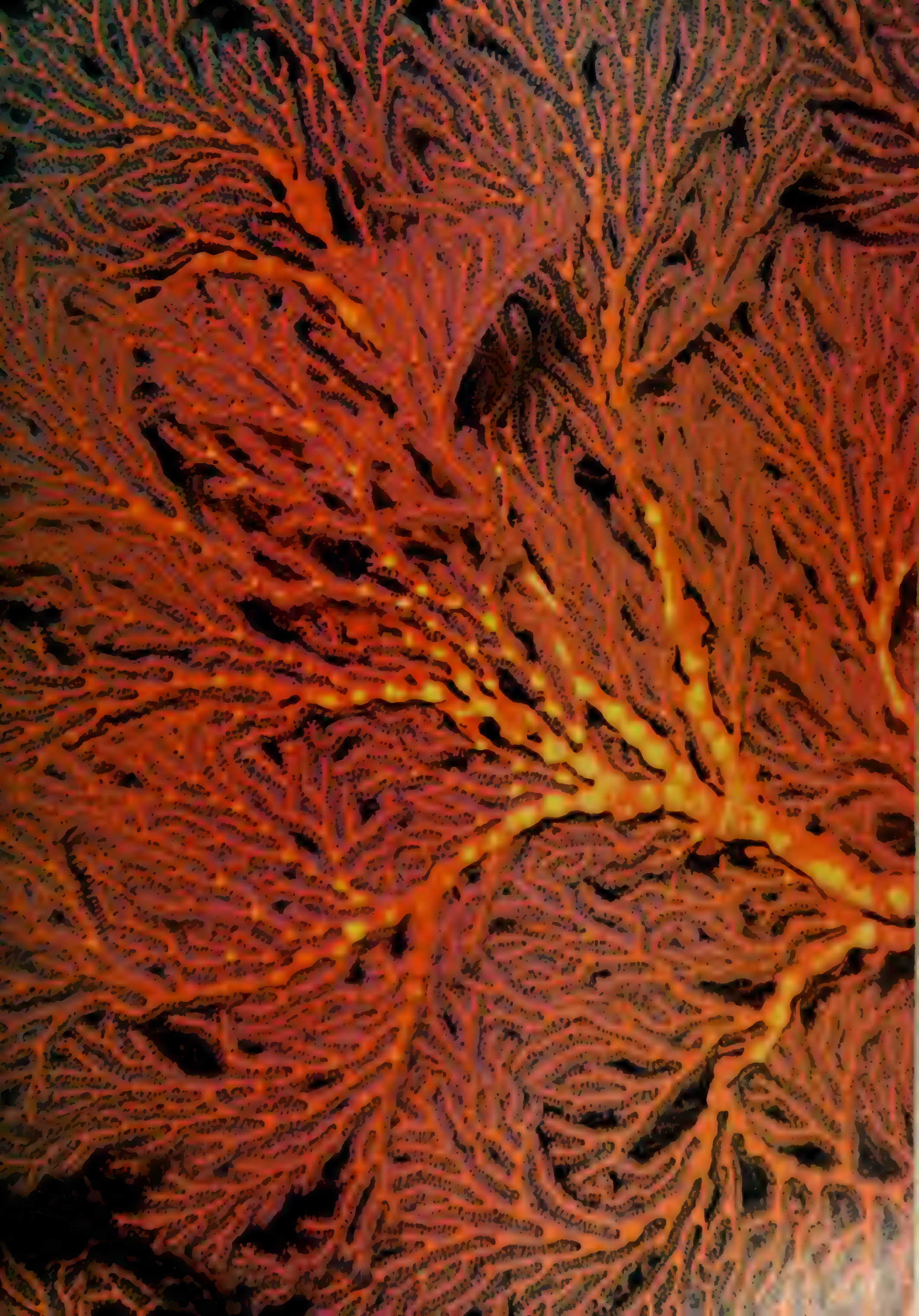
To a mariner, a reef is any submerged rocky obstruction that imperils his ship, but to a biologist it is an intricate community of living organisms, plants as well as animals, fashioned around a stony framework built by corals. The meaning of the word *coral* is vague and has changed through the ages since it was first used by the ancients. When used without qualification, however, coral now usually refers to the kinds that are the major reef builders, the stony corals.

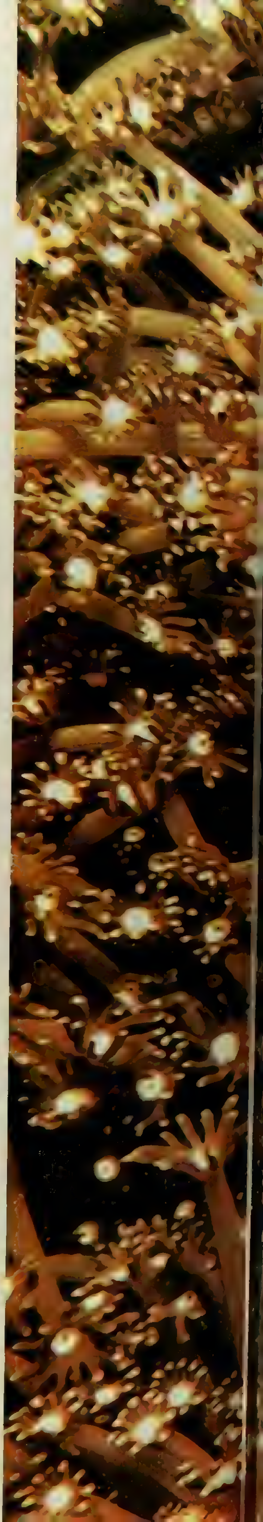
In the reef community, even though the stony corals form the framework, the flexible corals called gorgonians are a conspicuous and decorative part of the landscape. These two kinds of corals are coelenterates—relatives of the familiar jellyfishes and sea anemones—and live together in enormous numbers, each individual animal, or polyp, inseparably joined to its neighbors. Because of its covering of polyps the living coral on the reef looks strikingly different from the dead skeleton. The picture of a stony coral in the Palau Islands, *page 47,* shows the animals with their leaflike tentacles so far expanded that the shape of the skeleton is obscured, and not even the mouths of the polyps can be seen. The white, stony skeleton is completely covered by the living tissues. Other stony corals, *pages 44-46,* present wildly varied appearances.

The supple gorgonian corals lend color to the reef. They have a skeleton formed of millions of ornate, jewellike calcareous crystals, called spicules, which may be yellow, orange, red, or purple. The treelike, branching form is supported by an inner core of hornlike substance that may contain calcareous matter but still remains flexible. In some corals, the core has become so highly calcified that it is quite rigid, as in the case of the sea fan from Palau, *at right.* These have spongy joints at intervals between stiff segments, so they, too, are flexible. In the photographs the joints are clearly visible as swellings along the stem and branches. The long, pliable branches of the russet-colored sea whip from the Loyalty Islands, *cover,* do not have such joints. Each white, star-shaped fleck is a single, flowerlike polyp with its tentacles spread, ready to capture the tiny planktonic animals that drift helplessly in the ocean currents.

The reef is perhaps the most complex community in all of nature,

Photographs by Douglas Faulkner





where plants and animals of infinite variety live together in seeming confusion. But even here there is an orderly balance and interrelationship among organisms. The gorgonians provide concealment and shelter for fish, both hunter and hunted. Brittle stars and feather stars perch in their branches, and certain crabs and shrimps make their homes nowhere else. All the species of two important families of snails—the egg cowries and the coral snails—prey exclusively on the polyps of various corals. But the most fantastic relationship of all is the partnership, or symbiosis, between minute plant cells and the corals and most other coelenterates, whose living tissues they inhabit. These plants, known as zooxanthellae, need the carbon dioxide produced by the animal, which in turn utilizes the surplus oxygen and food produced by the plants through photosynthesis. Some corals, in fact, get all their food from the zooxanthellae and can live indefinitely without eating as long as their little plant cells are healthy. Perhaps most important, the zooxanthellae, through a complex enzyme system, increase the coral's ability to deposit calcium carbonate and so make it possible for them to produce the vast framework of the reef.

THE GREAT SISA

With dreams of riches, the peasants of northeastern Brazil planted crops of "green gold." They harvested instead malnutrition and misery

In northeastern Brazil, the lus
green coastal vegetation almo
hides the endemic human misery o
the region. Unless you look closel
the busy streets of Salvador an
Recife and the waving palm tre
mask the desperation of city slum
the poverty of plantation worker
When you leave the well-travele
coastal highways and go—usually o
a dusty, rutted road—toward the i
terior, the signs of suffering becom
more and more apparent.

The transition is quick an

SCHEME

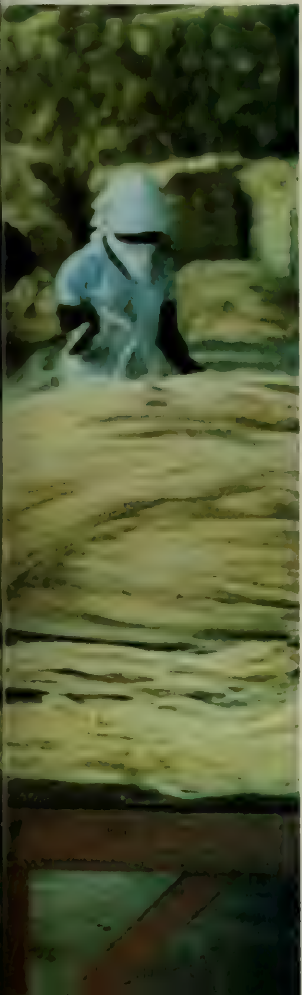
by Daniel R. Gross

rutal. Within 50 miles the vegetaion changes from palm, tropical ruit, and dark-green broad-leafed rees to scrawny brush only slightly reener than the dusty earth. Nearly every plant is armed with pines or thorns. The hills are jaged, with hard faces of rock exosed. This is the *sertão*, the interior f northeastern Brazil.

If the *sertão* were honest desert, t would probably contain only a ew inhabitants and a fair share of uman misery. But the *sertão* is deceitful and fickle. It will smile for several years in a row, with sufficient rains arriving for the growing seasons. Gardens and crops will flourish. Cattle fatten. Then, without warning, another growing season comes, but the rains don't. The drought may go on, year after dusty year. Crops fail. Cattle grow thin and die. Humans begin to do the same. In bad droughts, the people of the *sertão* migrate to other regions by the thousands.

The bandits, the mystics, the droughts and migrants, the dreams and schemes of the *sertão* hold a special place in Brazilian folklore, literature, and song. Even at its worst, the *sertão* has been a fertile ground for the human imagination.

For two years, I studied the impact of sisal crops—a recent dream and scheme—on the people of the *sertão*. Taking an ecological approach, I found that sisal, which some poetic dreamers call "green gold," has greatly changed northeastern Brazil. But the changes have



In the cities and towns of northeastern Brazil, sisal has brought a facade of industry and prosperity, such as the sisal-processing plant in Salvador, left, and some modern homes in Monte Santo, above.

Because their fields are planted with sisal, villagers now buy most of their food in small stores, above. A leather-clad *vaqueiro*, right, is a relic of the former cattle era.

not been what the economic planners anticipated. And misery has not left the *sertão*.

I lived in Vila Nova, a small village with a population of less than 500 about an hour's drive from the town of Victoria in Bahia State. Vila Nova is striking only for its drabness. Weeds grow in the middle of unpaved streets. Facing the plaza is an incomplete series of nondescript row houses. Some have faded pastel façades, others are mud brown because their owners never managed to plaster over the rough adobe walls. The village looks decadent, yet the oldest building is less than 20 years old and most were built after 1963.

Cattle raisers settled the *sertão* 400 years ago when the expanding sugar plantations of the coast demanded large supplies of beef and traction animals. A "civilization of leather" developed, with generations of colorful and intrepid cowboys (*vaqueiros*) clad entirely in rawhide to protect themselves against the thorny scrub vegetation. As the population of the *sertão* grew, many *sertanejos* settled down to subsistence farming. Gradually the entire region became a cul-de-sac, with many small and medium-sized estates occupied by descendants of the *vaqueiros* and others who had drifted into the region.

Life was never easy in this thorny land, for the work was hard and the environment cruel. Yet cooperation and mutual assistance provided assurance of survival even to the poorest. The chief crops were manioc, beans, and corn, and most of what was grown was consumed by the cultivator's family. Most families received some share of meat and milk, and consumed highly nutritious foods like beans and squash, in addition to starchy foods like manioc flour.

When droughts menaced the region all but the wealthiest ranchers migrated temporarily to the coast to work on the sugar plantations. When the rains came again to the *sertão*, they nearly always returned, for the work in the cane fields was brutal and labor relations had not changed greatly from the time when slaves worked the plantations.

Originally from Mexico, sisal was introduced to Brazil early in this century and reached the *sertão* in the 1930's. Farmers found sisal useful for hedgerows because its tough, pointed leaves effectively kept out cattle. The cellulose core of the long sisal leaf contains hard fibers, which can be twisted together into twine and rope. When World War II cut off the supply of Manila hemp to the United States, buyers turned to Brazil for fiber. At first only hedgerow sisal was exploited, but the state of Bahia offered incentives for planting sisal as a cash crop. Since sisal plants require about four years to mature, Brazil did not begin to export the fiber in significant quantities until 1945. The demand persisted, and by 1951, Brazil was selling actively in the world market as prices rose.

In Vila Nova, a young entrepreneur who owned a mule team, David Castro, heard about the prices being paid for sisal fiber and planted the first acres of sisal in 1951. By 1968, in the county of Victoria where Vila Nova is located, so many people had caught "sisal fever" that half of the total land area was planted in the crop. Sisal is easily transplanted and cultivated, requires little care, and is highly resistant to drought. It has some drawbacks as a cultivated plant, however. At least one annual weeding is necessary or else the field may become choked with thorn bushes, weeds, and suckers (unwanted small sisal plants growing from the base of parent plants). A field abandoned for two years becomes unusable, practically unreclaimable. Despite these difficulties, many landowners planted sisal, especially in 1951 and 1962, years of high prices on the world market.

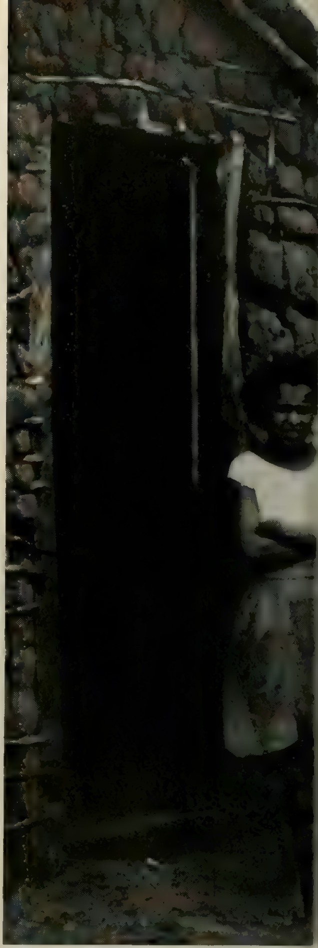
From the outset, sisal produced differential rewards for those who planted it. Owners of small plots (ten acres or less) planted proportionately more of their land in sisal than did large landowners. Many who owned just a few acres simply planted all their land in sisal in expectation of large profits. This deprived them of whatever subsistence they had managed to scratch out of the ground in the past. But work was easy to find because the need for labor in the sisal fields grew rapidly. When, after four years, the crops were ready to harvest, many small landholders discovered to their dismay that prices had dropped sharply, and that harvest teams did not want to work small crops. They had planted sisal with dreams of new clothes, new homes, even motor vehicles purchased with sisal profits, but found their fields choked with unusable sisal and became permanent field laborers harvesting sisal on large landholdings. In this way, sisal created its own labor force.

The separation of sisal fiber from the leaf is known as decortication. In Brazil, this process requires enormous amounts of manual labor. The decorticating machine is basically a spinning rasp powered by a gasoline or diesel motor. Sisal leaves are fed into it by hand, and the spinning rasp beats out the pulp or residue leaving only the fibers, which the worker pulls out of the whirling blades. Mounted on a trailer, the machine is well adapted to the scattered small-scale plantations of northeastern Brazil.

The decortication process requires constant labor for harvesting the year round. Sisal leaves, once cut, must be defibered quickly before the hot sun renders them useless. Each decorticating machine requires a crew of about seven working in close coordination. The first step is harvesting. Two cutters move from plant to plant, first lopping off the needle-sharp thorns from the leaves, then stooping to sever each leaf at the base. A transporter, working with each cutter, gathers the leaves and loads them on a burro. The leaves are taken to the machine and placed on a low stage for the defiberer to strip, one by one. A residue man removes the pulpy mass stripped from the leaves from under the motor, supplies the defiberer with leaves, and bundles and ties the freshly stripped fiber. Each bundle is weighed and counted in the day's production. Finally, the dryer spreads the wet, greenish fiber in the sun, where it dries and acquires its characteristic blond color.

For the planters and sisal buyers, this method of decortication operates profitably, but for the workers it exacts a terrible cost. The decorticating machine requires a man to stand in front of the whirling rasp for four or five hours at a shift, introducing first the foot and then the point of each leaf. The worker pulls against the powerful motor, which draws the leaf into the mouth of the machine. After half of each leaf is defibered, the defiberer grasps the raw fiber to insert the remaining half of the leaf. There is a constant danger that the fiber will entangle his hand and pull it into the machine. Several defiberers have lost

Sertao
SOUTH AMERICA
BRAZIL
Rio de Janeiro



All the working-age members of this family in the state of Paraíba had jobs harvesting sisal, but their combined wages were barely enough to supply the household with food.

arms this way. The strain and danger would seem to encourage slow and deliberate work; but in fact, defiberers decorticate about 25 leaves per minute. This is because the crew is paid according to the day's production of fiber. Although the defiberer is the highest-paid crew member, many of them must work both morning and afternoon shifts to make ends meet.

A residue man's work is also strenuous. According to measurements I made, this job requires that a man lift and carry about 2,700 pounds of material per hour. The residue man, moreover, does not work in shifts. He works as long as the machinery is running. The remaining jobs on the crew are less demanding and may be held by women or adolescents, but even these jobs are hard, requiring frequent lifting and stooping in the broiling semidesert sun.

With their own fields in sisal, to earn money the villagers had to work at harvesting sisal for large landowners. And because wages were low, more and more people had to work for families to survive. In 1968 two-thirds of all men and women employed in Vila Nova worked full time in the sisal decorticating process. Many of these were youths. Of 33 village boys between the ages of 10 and 14, 24 worked on sisal crews. Most people had completely abandoned subsistence agriculture.

Sisal brought other significant changes in the life of Vila Nova. Because most villagers no longer grew their food, it now had to be imported. Numerous shops, stocking beans, salt pork, and manioc flour, grew up in the village. A few villagers with capital or good contacts among wholesalers in the town of Victoria built small businesses based on this need. Other villagers secured credit from sisal buyers in Victoria to purchase sisal decorticating machinery.

The shopkeepers and sisal machine owners in the village formed a new economic class on whom the other villagers were economically dependent. The wealthier group enjoyed many advantages. Rather than going to work on the sisal machines, most of the children of these entrepreneurs went to school. All of the upper group married in a socially prescribed way: usually a church wedding with civil ceremonies as well. But among the workers, common-law marriages were frequent, reflecting their lack of resources for celebrating this important event.

The only villagers who became truly affluent were David Castro and his cousin. These men each owned extensive sisal plantations and several decorticating units. Most importantly, each became middlemen, collecting sisal in warehouses in the village and trucking the fiber into Victoria. David, moreover, owned the largest store in the village. Since the village was located on David's land, he sold house plots along the streets. He also acted as the representative of the dominant political party in Victoria, serving as a ward boss during elections and as an unofficial but effective police power. There was a difference betweeen David and the large ranch owners of the past. While wealthy men were formerly on close terms with their dependents, helping them out during tough times, David's relations with the villagers were cold, businesslike, and exploitative. Most of the villagers disliked him, both for his alleged stinginess and because he never had time to talk to anyone.

During my stay in Vila Nova I gradually became aware of these changes in the social and economic structure. But I hoped to establish

CALORIE BUDGET OF A SISAL WORKER'S HOUSEHOLD

	Average daily caloric intake	Minimum daily caloric requirements	Percent of need met	Percent of standard weight of children
Household	9,392	12,592	75%	
Worker	3,642	3,642	100	
Wife	2,150	2,150	100	
Son (age 8)	1,112	2,100	53	62%
Daughter (6)	900	1,700	53	70
Son (5)	900	1,700	53	85
Son (3)	688	1,300	53	90

that the introduction of sisal had also resulted in a quantitative, ecological change in the village. At the suggestion of Dr. Barbara A. Underwood of the Institute of Human Nutrition at Columbia University, I undertook an intensive study to determine what influence sisal had on diet and other factors of a few representative households. When I looked at household budgets, I quickly discovered that those households that depended entirely on wages from sisal work spent nearly all their money on food. Families with few or no children or with several able-bodied workers seemed to be holding their own. But families with few workers or several dependents were less fortunate. To understand the condition of these families, I collected information not only on cash budgets but also on household *energy budgets*. Each household expends not only money, but also energy in the form of calories in performing work. "Income" in the latter case is the caloric value of the foods consumed by these households. By carefully measuring the amount and kind of food consumed, I was able to determine the total inflow and outflow of energy in individual households.

For example, Miguel Costa is a residue man who works steadily on a sisal unit belonging to a nearby planter. He lives in Vila Nova in a two-room adobe hut with his wife and four small children, ranging in age from three to eight. During the seven-day test period, Miguel worked at the sisal motor four and a half days, while his wife stayed home with the children. I was able to estimate Miguel's caloric expenditures during the test period. During the same period, I visited his home after every meal where his wife graciously permitted me to weigh the family's meager food supplies to determine food consumption. Each day the supply of beans diminished by less than one-half pound and the weight of the coarse manioc flour eaten with beans dropped by two or three pounds. Manioc flour is almost pure starch, high in calories but low in essential nutrients. At the beginning of the week about half a pound of fatty beef and pork were consumed each day, but this was exhausted by midweek. The remainder of the family's calories were consumed in the form of sugar, bread, and boiled sweet manioc, all high in calories but low in other nutrients.

Estimating the caloric requirements of the two adults from their activities and the children's by Food and Agriculture Organization minimum requirements, the household had a minimum need of 88,142 calories for the week. The household received only 65,744 calories, or 75 percent of need. Since the two adults did not lose weight while maintaining their regular levels of activity, they were apparently meeting their total calorie requirements. Miguel, for example, had been working steadily at his job for weeks before the test and continued to do so for weeks afterward. Had he not been maintaining himself calorically, he could not have sustained his performance at his demanding job. Despite his small stature (5 feet, 4 inches) Miguel required some 3,642 calories per day to keep going at the job. And Miguel's wife evidently also maintained herself calorically—pregnant at the time of my visit, she later gave birth to a normal child.

The caloric deficit in Miguel's household, then, was almost certainly being made up by systematically depriving the dependent children of sufficient calories. This was not intentional, nor were the parents aware of it. Nor could Miguel have done anything about it even if he had understood this process. If he were to work harder or longer to earn more money, he would incur greater caloric costs and would have to consume more. If he were to reduce his food intake to leave more food for his children, he would be obliged by his own physiology to work less, thereby earning less. If he were to provide his household with foods higher in caloric content (for example, more manioc), he would almost certainly push his children over the brink into a severe nutritional crisis that they might not survive for lack of protein and essential vitamins. Thus, Miguel, a victim of ecological circumstances, is maintaining his family against terrible odds.

Miguel's children respond to this deprivation in a predictable manner. Nature has provided a mechanism to compensate for caloric deficiencies during critical growth periods: the rate of growth simply slows down. As a result, Miguel's children, and many other children of sisal workers, are much smaller than properly nourished children of the same age. The longer the deprivation goes on the more pronounced the tendency: thus Miguel's youngest boy, who is three, is 90 percent of standard weight for his age. The five-year-old boy is 85 percent; the six-year-old girl, 70 percent; and the oldest boy, at eight, is only 62 percent of standard weight. Caloric deprivation takes its toll in other ways than stunting. Caloric and other nutritional deficiencies are prime causes of such problems as reduced mental capacity and lower resistance to in-

After a day's labor, a father and his daughters return home along a path in a poorly tended sisal field, above. Unless the field is harvested within a year—which is unlikely—it will be worthless. The most strenuous jobs in harvesting, right, are those of the residue man, bending, and the defiberer.

fection. In Vila Nova one-third of all children die by the age of 10.

When I surveyed the nutritional status of the people of Vila Nova, I found a distinct difference between the average body weights of the two economic groups formed since the introduction of sisal (shopkeepers and motor-owners on the one hand, and workers on the other). Since the introduction of sisal the upper economic group exhibited a marked improvement in nutritional status (as measured by body weight) while the lower group showed a decline in nutritional status. The statistics showed that while one group was better off than before, a majority of the population was actually worse off nutritionally.

This conclusion was unexpected in view of the widespread claim that sisal had brought lasting benefits to the people of the *sertão*, that sisal had narrowed the gap between the rich and the poor. Clearly, changes had come about. Towns like Victoria had grown far beyond their presisal size.

But outside the towns, in the villages and rural farmsteads, the picture is different. Having abandoned subsistence agriculture, many workers moved to villages to find work on sisal units. In settlements such as Vila Nova wages and profits depend on the world price for sisal. When I arrived in 1967, the price was at the bottom of a trough that had paralyzed all growth and construction. Wages were so low that outmigration was showing signs of resuming as in the drought years. In spite of local symbols of wealth and "development," my observations revealed a continuation of endemic poverty throughout most of the countryside and even an intensification of the social and economic divisions that have always characterized the *sertão*.

Sisal is not the only example of an economic change that has brought unforeseen, deleterious consequences. The underdeveloped world is replete with examples of development schemes that brought progress only to a privileged few. The example of sisal in northeastern Brazil shows that an ecological approach is needed in all economic planning. Even more important, we must recognize that not all economic growth brings social and economic development in its true sense. As the sisal example shows, a system may be formed (often as part of a worldwide system) that only increases the store of human misery.

Ecocide in Indochina

In pursuit of an enemy with an ecologic advantage, we have scraped, poisoned, and pockmarked vast areas of Vietnam. The scars could last for centuries

by Arthur H. Westing

All wars raise havoc with the land on which they are fought. However, our war in Indochina has been, and continues to be, particularly disruptive of the environment.

The country is largely rural, and the enemy is dispersed in the fields and forests, in the mountains and swamps. This enemy matches his numbers and concealment and persistence against our wealth and technology and persistence. They hide and we seek.

In an attempt to cope with that elusive enemy, dispersed and hidden in the wild stretches of Vietnam, the United States military employs two major tactics: bombing on a staggeringly unprecedented scale and laying bare vast stretches of terrain. Both tactics are enormously disruptive of the ecology (and economy) of Vietnam.

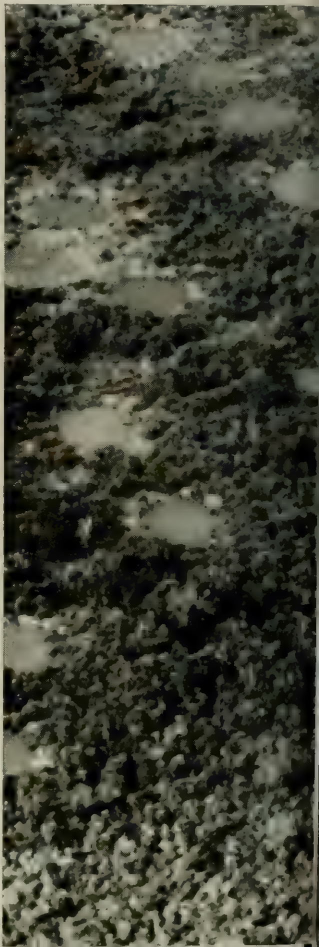
When an area is found to contain—or is even suspected of containing—Vietcong, it is subjected to intensive aerial bombardment. Hundreds of bombing sorties are flown each day. Some three million bombs are dropped annually, for a total new of more than ten million tons, and the program is being intensified daily. In flying over the country, as I did last August, one is overwhelmed by the endless craters, each 20 or 30 feet deep and 30 to 40 feet across. These ubiquitous craters are (at least during the rainy season) usually filled with water and provide an ideal breeding habitat for malarial mosquitoes. The long-term ecological effects, possibly for centuries, of this massive intrusion of the environment have attracted little attention.

The other massive ecological disturbance is our program of defoliation: the destruction of vast stretches of vegetation in order to deny cover and sanctuary to the enemy. This is done in two major ways. One rather straightforward approach is to bulldoze the countryside. Using giant tractors equipped with sharpened Rome-plow blades, we have now cleared a 1,000- to 2,000-yard strip along most major transportation routes. Most of these swaths—often scraped down to the infertile subsoil—are barren and subject to erosion. The remainder are largely weed-choked wastelands. They will be difficult to reclaim and rehabilitate after the war.

In addition to roadside clearing, large contiguous areas of countryside are Rome-plowed to deny them to the enemy. At least one-half million acres of forest were cleared through 1969, according to information released by the Army. This program continues unabated. In the words of the commanding officer of this operation, "The B-52 bomber is the battle-ax of this war, and our plow is the scalpel."

The second and much more extensive means we have devised for denying wild land cover and sanctuary to the other side is the aerial application of plant poisons, or herbicides. This aspect of the war drew me to Indochina twice, most recently in August, 1970, as director of the Herbicide Assessment Commission of the American Association for the Advancement of Science (AAAS). There is no precedent for the massive use of herbicides in a tropical environment and thus no way of reliably predicting the full extent and seriousness of the damage being inflicted upon the ecology of Vietnam. The likelihood of serious long-term damage to the environment has been a major concern of many scientists in this country and elsewhere. In December, 1970, the Council of the AAAS resolved to urge the United States to renounce the military use of herbicides.

War against the plants of Vietnam began in late 1961 and, ac-

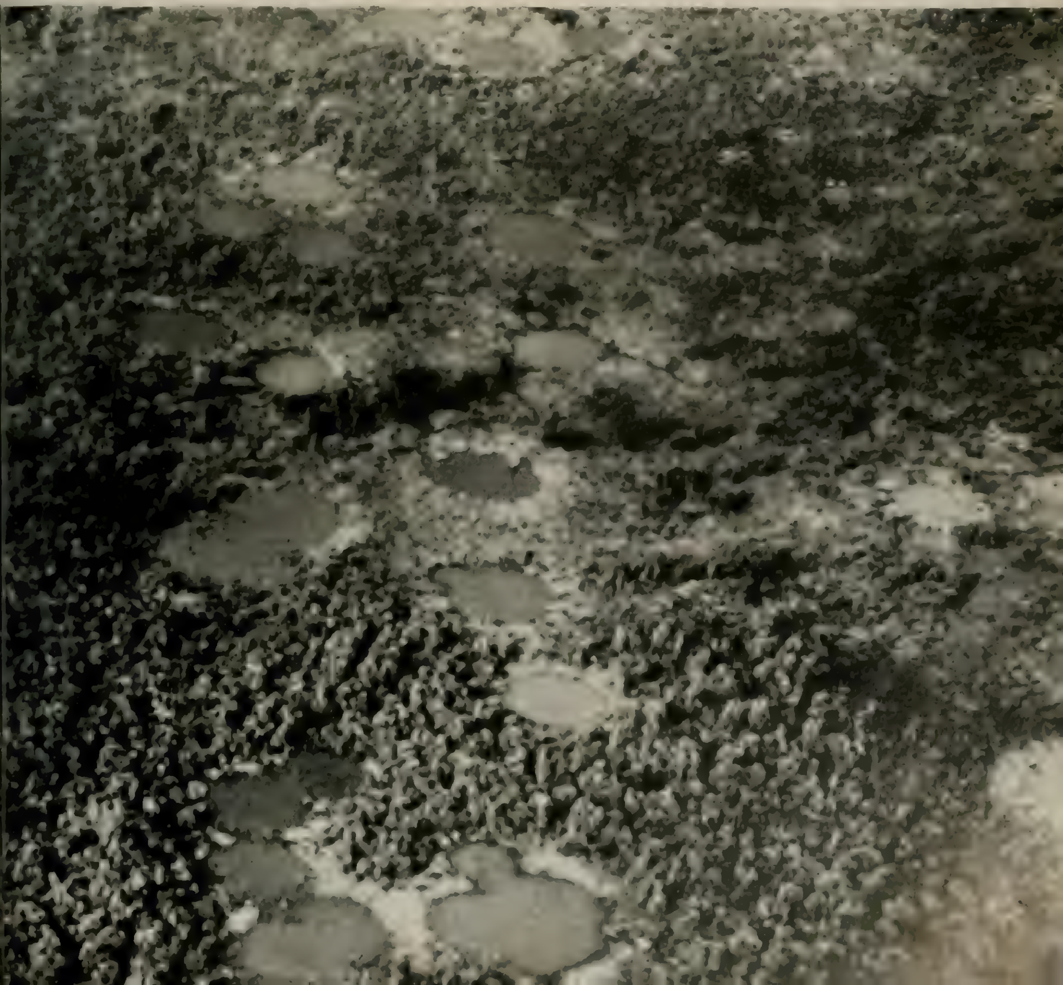


cording to a recent Department of Defense news release, was inflicted upon some 5½ million acres through 1969. Since the program continues to this day, the current figure can be estimated to be in excess of 6½ million acres. (A half million or more acres classified as agricultural have been sprayed.) All told, one acre in six in South Vietnam has now been sprayed.

To illustrate the extent of environmental disruption more graphically: South Vietnam approximates the size of New England; the area sprayed is larger than Vermont: the area bulldozed almost that of Rhode Island. While none of Vietnam's 43 provinces has escaped, some have been attacked herbicidally with particular intensity and frequency. Among these are the Rung Sat region in Gia Dinh Province southeast of Saigon, Tay Ninh Province (War Zone C), which is northwest of Saigon, and Long Khanh Province (War Zone D) northeast of Saigon—the last previously contained major stands of South Vietnam's magnificent virgin tropical forest.

Most forest spraying has been done with a 1:1 mixture of 2,4-D and 2,4,5-T, Agent Orange in mili-

In War Zone D, bomb craters pockmark the forest. Filled with water much of the time, these holes are breeding grounds for malarial mosquitos.

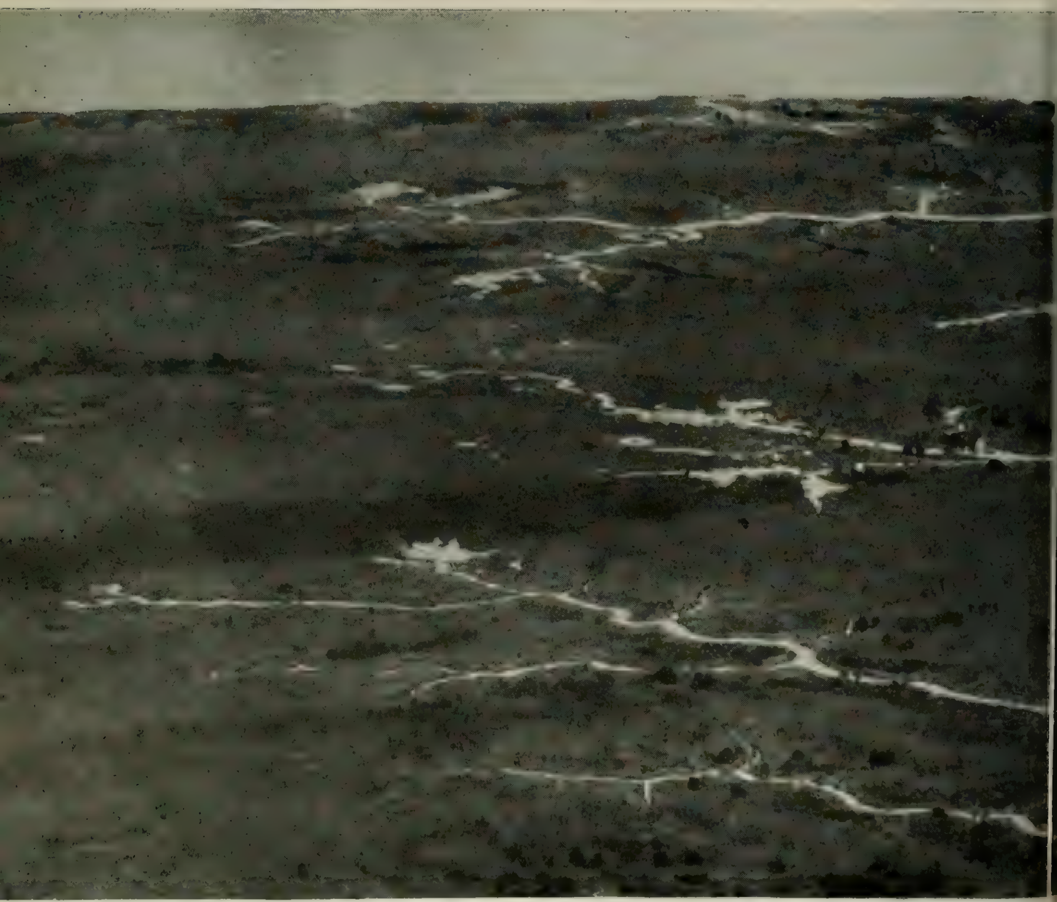


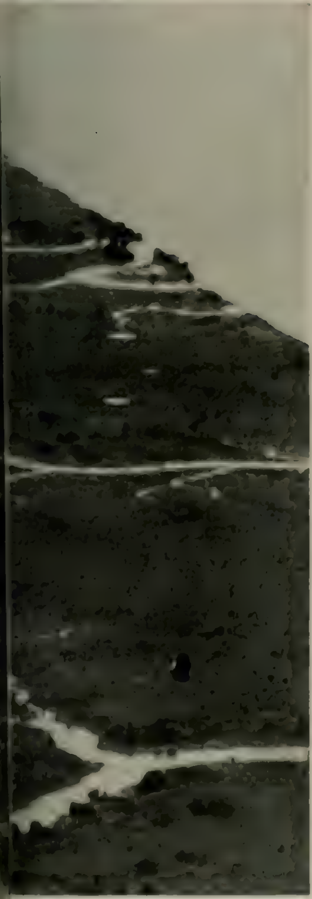
tary terminology; some with a 4:1 mixture of 2,4-D and picloram, or Agent White; and small amounts with dimethyl arsenic acid, Agent Blue. The use of Agent Orange was discontinued in early 1970, largely in favor of Agent White. Agent Orange was applied at the rate of 25 pounds of active ingredients per acre; Agent White at 8 pounds; and Agent Blue at 9.

When an upland forest is attacked with herbicide, the leaves drop after two or three weeks and the trees remain bare for several months. Sunlight, able to reach the forest floor following defoliation, promotes the growth of a luxuriant understory in which certain herbaceous grasses and shrubby bamboos dominate. A tropical forest has an enormous diversity of species, some more sensitive to the spray than others. When refoliation of the trees occurs, about one out of ten trees fails to survive the treatment, perhaps more. This has occurred on more than 5 million acres in Vietnam. The repeated spraying of an additional million acres or so of upland forest has caused even more serious damage. In such areas the proportion of trees killed rises dramatically, as much as 50 percent to 80 percent or higher, depending upon the number of applications, the type of spray, and the local mix of species. An estimated 6½ billion board feet of merchantable tropical timber have been destroyed, plus an

Swaths a thousand yards wid have been cut through th forest on each side of this roa in War Zone C. These plowe areas are subject to erosion

Years after the mangrove vegetation was sprayed, much of the Mekong Delta remains gray and dead. The life cycles of many fishes and crustaceans depend on nutrients from such swamps.





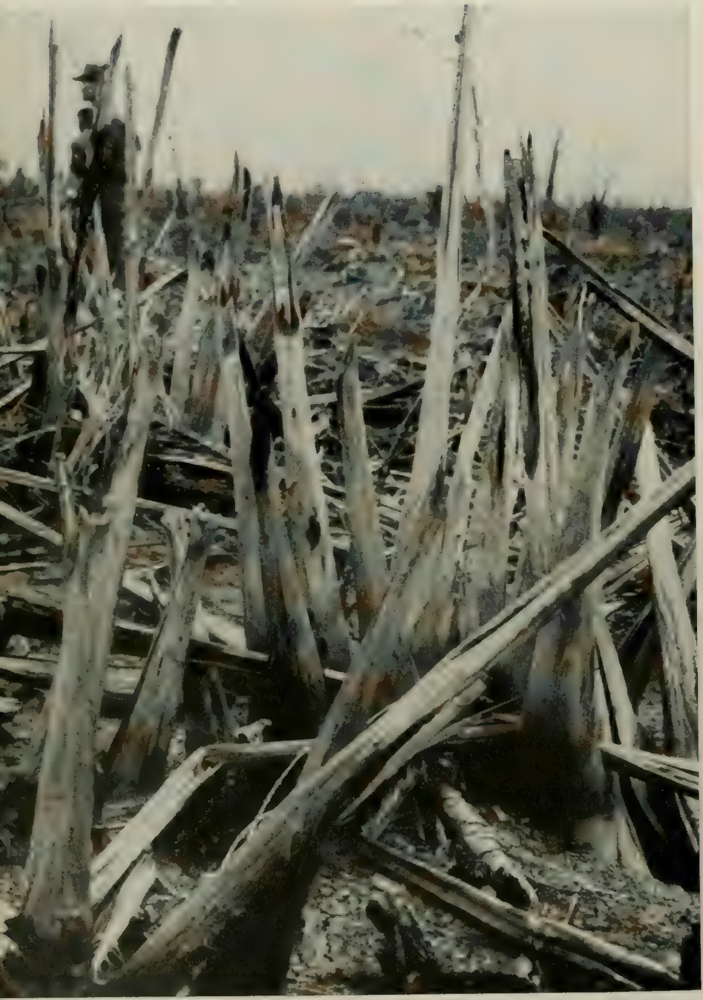
indeterminate amount of fuel wood, charcoal wood, and other forest products.

In flying over these hard-hit areas, I was impressed by the widespread invasion of cogon grass (*Imperata*) or, even worse, a variety of low-growing scrub bamboos. These species are aggressive colonizers and prevent the re-establishment of the former high forest. The resultant grass savannas and bamboo brakes have a reduced biomass and an impoverished fauna. Commercially worthless, they will be extremely difficult to eradicate. These vegetational wastelands will remain one of the legacies of our presence for decades to come.

Additional, less obvious ecological damage is likely to occur in a sprayed upland forest. In a tropical forest ecosystem (unlike those of temperate zones) the major fraction of the total nutrient budget is in its biotic component (largely in the leaves and small twigs). Following defoliation, a significant fraction of the leaf-stored nutrients is probably lost permanently in the water runoff. It takes decades for a tropical ecosystem to restore its former productivity following such nutrient dumping.

Herbivorous insect, bird, and bat populations are bound to decline markedly and with them, their pollinating function, which is so important in a tropical forest where individual plants of the same species are usually widely scattered. In the replacement community, particularly following multiple herbicidal attacks, the original set of animal populations will be replaced by a less diverse set. A large number of species will be eliminated and the replacement community will have higher numbers of fewer species, many of them new to the area. In addition, the miles of borders (or ecotones) between divers vegetational types is being greatly increased. Such a fringe habitat supports its own animal community. For example, the scrub typhus mite appears to be restricted to such a niche.

The chemicals used for defoliation missions (largely 2,4-D, 2,4,5-T, and picloram) are potent herbicides but are supposedly not toxic to animals. These chemicals have their main effect on terrestrial animals (both large and microscopic) indirectly via the dependence of these animals on plants for food and shelter. However, at least one of the herbicides, 2,4,5-T, contains dioxin as an impurity. Dioxin is both highly toxic and enormously teratogenetic (causing birth defects) to mammals. Vietnam's countryside has been drenched over the years with some 47 million pounds of 2,4,5-T, with an estimated dioxin concentration of 25 parts per million. This means that [illegible]



A single application of herbicide killed all the nipa palms, which are used for thatch, in this swamp forest in Gai Dinh Province, southeast of Saigon.

One spraying—by mistake—killed these rubber trees on a French-owned plantation in Long Khanh Province. Vigorous cogon grass has invaded the area.

one thousand pounds of dioxin have been introduced into Vietnam's environment. Dioxin's environmental stability, mobility, and possible points of concentration in the ecosystem are not yet known.

In a different ecological situation, more than one million acres of Vietnam's southerly coastal regions are subject to daily flooding at each high tide. This tidal zone supports a characteristic biotic community known as mangrove swamp. It is an inhospitable region used mainly as a source of charcoal and as sanctuary for the ubiquitous Vietcong. More subtly, it is a crucial breeding and nursing ground for a great variety of ocean fishes and crustaceans and some river fishes.

To date, more than one-quarter of Vietnam's mangrove association has been sprayed and killed. I say *killed* because, through some quirk of nature. one herbicidal attack of this tidal zone literally kills all the plant life that grows there. Moreover, for unknown reasons, the plants do not regenerate. The utter devastation that results is eerie to behold and also frightening because I could find no indication of how soon, if ever, recovery would occur. Tens of thousands of acres sprayed years ago still have no sign of green on them. The web of life on these vast stretches has been destroyed, with ecological ramifications—and even geologic ones via marine erosion—not yet possible to fathom. Whether or not the recent disappearance of the freshwater tarpon, which breeds among the mangroves, from the Mekong Delta is the result of this destruction remains to be determined.

My focus has been on the strictly ecological impact of the military use of herbicides in a tropical setting. What must be left for another time is the impact of this program on human ecology—on the 17 million semidestitute Vietnamese peasants and primitive hill tribesmen inexorably enmeshed in the vagaries of the war. This unfortunate aspect of the problem has incredibly serious economic, public health, and social welfare dimensions.

Whatever one's political and moral views may be toward the war in Indochina, one has to assume that the war will end some day and that the surviving population must have a natural resource to support itself. The natural resource is the base upon which an underdeveloped country must build its future.

In December the White House announced a "phasing out" of the use of herbicides. It is my hope that a second statement is imminent announcing the immediate cessation and abrogation of such use of herbicides. I hasten to add that I have little against the discriminate civil use of many herbicides; I am only against their massive and indiscriminate use by the military. One cannot destroy a nation in order to save it.

Sky Reporter

New Neighbors Don't look now, but we're being followed—by something that weighs about 100 billion suns. We won't be able to see it for another 100 million years or so, but the people who know say it's there. In fact, they say that there are two of them, separated by little more than the apparent diameter of the moon.

The "them" are galaxies, as big as our own or that of our neighboring giant, the Andromeda galaxy. From our vantage point, the two "new" ones are directly behind dust clouds in our own galaxy, and so we cannot see them. (In 100 million years, our galaxy will have rotated enough so that we can.) But two years ago an Italian astronomer, Paolo Maffei, reported finding two strange objects on an infrared photograph he made of a region in the sky between the constellations Perseus and Cassiopeia. His paper in the *Publications of the Astronomical Society of the Pacific* caused enough stir in West Coast astronomical circles to warrant precious time on the big California telescopes.

Now nine of the researchers, writing in *Astrophysical Journal Letters,* say the two objects found by Maffei are really galaxies (an identification he now claims he made all along). Most of their paper concerns Maffei 1, which they say is probably elliptical, rather than spiral, and not much farther away than the Andromeda galaxy. Perhaps three million light-years away, it is on the edge of—but apparently not gravitationally bound to—the group of galaxies in this corner of the universe known familiarly as the Local Group.

A future paper will be devoted to Maffei 2, which the researchers believe is smaller and probably a spiral.

Good-bye, Venus . . . Our sister planet Venus, now shining brightly in the morning twilight, has been pretty much written out of the U.S. space program. We have not been there since 1967, when Mariner 5 flew by at a distance of 2,400 miles, and the only flight currently planned is a 1973 fly-by in a mission centered on the study of Mercury.

The Soviet Union, still firing off probes designed to land on the Venusian surface, has apparently succeeded on the third try. Six weeks after Venus 7 arrived at its destination on December 15, the Russian news agency reported that the probe had transmitted information for 35 minutes while descending through the superdense atmosphere, and for another 23 minutes after it came to rest on the surface. The basic data radioed back to earth were not surprising: the surface temperature was about 900 degrees and the atmospheric pressure about 90 times that at sea level on earth.

In the United States few people are excited about exploring Venus, and fewer still are prepared to argue against spending the money elsewhere. But it appears to be national policy to devote at least a minimal fraction of our national wealth to maintaining some expertise in interplanetary flight. If the national government insists on spending money for space exploration, the real question then becomes how the money can best be spent.

At this level the answers are varied and the debate vigorous. Some want manned exploration all the way:

Earthbound eyes and telescopes see only the featureless cloud banks of Venus, and there is little prospect for a better picture. Spacecraft are launched to Venus when it comes closest to earth, and at that time—because Venus is closer to the sun—the side of the planet facing earth is in darkness. Even if a television camera could be landed, it could not record images in the Venusian night. If a capsule landed on the bright side, facing away from earth, it could not send signals back to earth.

flights to Mars as soon as possible, landings on asteroids, manned stations in space and on the moon. Others think we can learn more about the solar system by spreading our available money over many economical, unmanned probes, launching them toward planets and other bodies at every opportunity.

The latter is the view of the Space Science Board of the National Academy of Sciences. In 1968, the board convened a meeting of planetary experts to work up strategies for learning more about our neighboring planets. They unanimously recommended taking advantage of every launch opportunity with probes that would cost about half as much as the Mariners now used. That suggestion disappeared like one of the early Russian probes sinking beneath the Venusian clouds.

Now the board has said it again, hoping its recommendations will have a little more impact the second time around. A new 21-man study group, headed by Richard M. Goody of Harvard and Donald M. Hunten of Kitt Peak National Observatory, has offered eloquent reasons for making virtually the same recommendations. In a 79-page report, they argue that terrestrial studies now encompass the entire solar system; we need to know all we can about all the planets to solve such problems as the origin of the solar system and the origin of life, and to better understand the large-scale processes that control a planet's environment. Even the meager data received from Venus so far, they say, have led earth scientists to revise their views about the earth's ionosphere and about tropical meteorology.

They add, with an eye to the prevailing political winds, "The question of why Venus has a complete cloud cover and a high surface temperature is beginning to interest those concerned with possible environmental changes on earth."

. . . Hello, Eros? With lunar landings behind us, the next logical place to land men is Mars, right? Not necessarily.

Other objects come closer than Mars, could be easier to land on and leave than Mars, and almost certainly would tell us more about the early solar system than any planet. They are the asteroids, those irregularly shaped chunks, ranging in size from a few hundred miles across down to pebbles, that never quite got it all together as a planet.

Two proponents of a mission to an asteroid, Hannes Alfven and Gustaf Arrhenius, argued in *Science* last year that because we already have samples of small solar system bodies in the meteorites and samples of large bodies from the earth and the moon, it makes the most sense to try to secure a piece of an intermediate-sized body. A spaceship could land on a large asteroid and take samples, or it could simply capture a very small one (say a couple of hundred pounds) and bring it back (either to earth's surface or to an orbit around the earth where it could be studied).

The best shot appears to be Eros, which will come to within 14 million miles of the earth in 1975. This is some 60 times the distance to the moon, but still considerably less than halfway to Mars. The landing would be more akin to docking; the authors say a spacecraft could bring itself to rest relative to the asteroid a mile or two away and the very weak gravity of the asteroid would gently draw the spacecraft down to its surface.

Eros is something like 10 miles in diameter. Working in nearly zero gravity (but not quite zero; they would not have to be tethered) astronauts could cover and sample the entire surface in a matter of hours.

Critics say Alfven and Arrhenius have oversimplified any such mission. A letter in a later issue of *Science* pointed out that many asteroids, Eros among them, are known to be rotating and may well be going through other, more complicated motions at the same time, a situation that would make landing a tricky business. That same spin could cancel out the asteroid's very weak gravity, making it more difficult to land and to move around on the asteroid's surface.

Alfven and Arrhenius reply that even at the extremities of a brick-shaped object like Eros, the rotational velocities would not be great. And presumably, they add, astronauts would study the target as they approached and then pick an optimal landing site.

Like the members of the Venus study group, Alfven and Arrhenius are now waiting to see if anybody's listening.

JOHN P. [illegible]

Celestial Events

The moon is in its waning gibbous stage by mid-March, rising in late evening and remaining in the sky at dawn. Last-quarter is on March 19, and new moon occurs March 26. The waxing crescent ought to be visible in the evening by March 29, and becomes first-quarter on April 2. Full moon occurs April 10.

Venus, Jupiter, and Mars continue to dominate the morning sky while Mercury joins Saturn as an evening star in late March and early April. Venus, now well past maximum brilliancy, is still the brightest object of the morning sky, rising south of east about two hours before the sun. Jupiter rises still earlier, about midnight. Though dimmer than Venus, it dominates the southern sky at dawn, where it far outshines the brightest star in Scorpius, Antares, nearby to the south of the planet. Mars rises after Jupiter, to the left of Antares, and is similar in color and brightness to the star.

In the evening, Saturn is in Aries, located in the southwest at dusk, and sets before midnight. Mercury goes through a favorable evening elongation in early April. During the last week of March and the first week of April, there is a good chance of seeing the elusive planet just above the western horizon about an hour after sundown.

March 18: In the morning sky, the waning gibbous moon passes between Jupiter, above the moon, and Antares, the brightest star in Scorpius, below and much closer to the moon.

March 20: You should find Mars easily this morning by looking above and to the left of the moon, just a few hours past last-quarter. Look for a reddish star about first magnitude. Jupiter, much brighter, is far to the right. Venus rises in the late morning, to the left of, and below, the moon.

March 21: The long winter comes to an end at 1:38 a.m., EST, when the sun arrives directly over the earth's Equator.

March 23-24: The crescent moon rises just before Venus on the morning of the 23rd, just after Venus on the 24th, and moves from right to left of the planet on the two mornings.

March 26: The perigee moon (when it is nearest earth) occurs ten hours before new moon. Expect higher than usual tides.

March 27: The bright object below the crescent moon this evening is Saturn. Look for Mercury below and to the right of Saturn.

April 1: Mercury is at greatest elongation in the evening sky. This is a favorable elongation; the planet is well above the horizon at sunset and ought to be visible as an evening star on clear nights, low in the west in the twilight, for about a week before and after April 1.

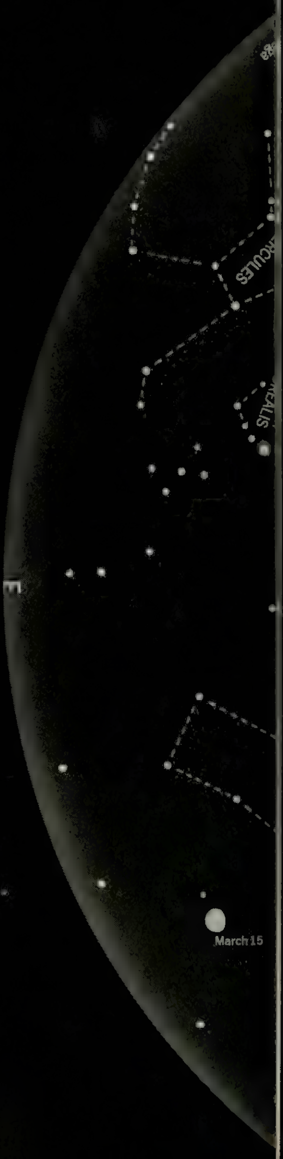
April 5-6: The bright star near the moon on these evenings is Regulus, in Leo. It is to the left of the moon on the evening of the 5th, about the same distance to the right of the moon on the 6th.

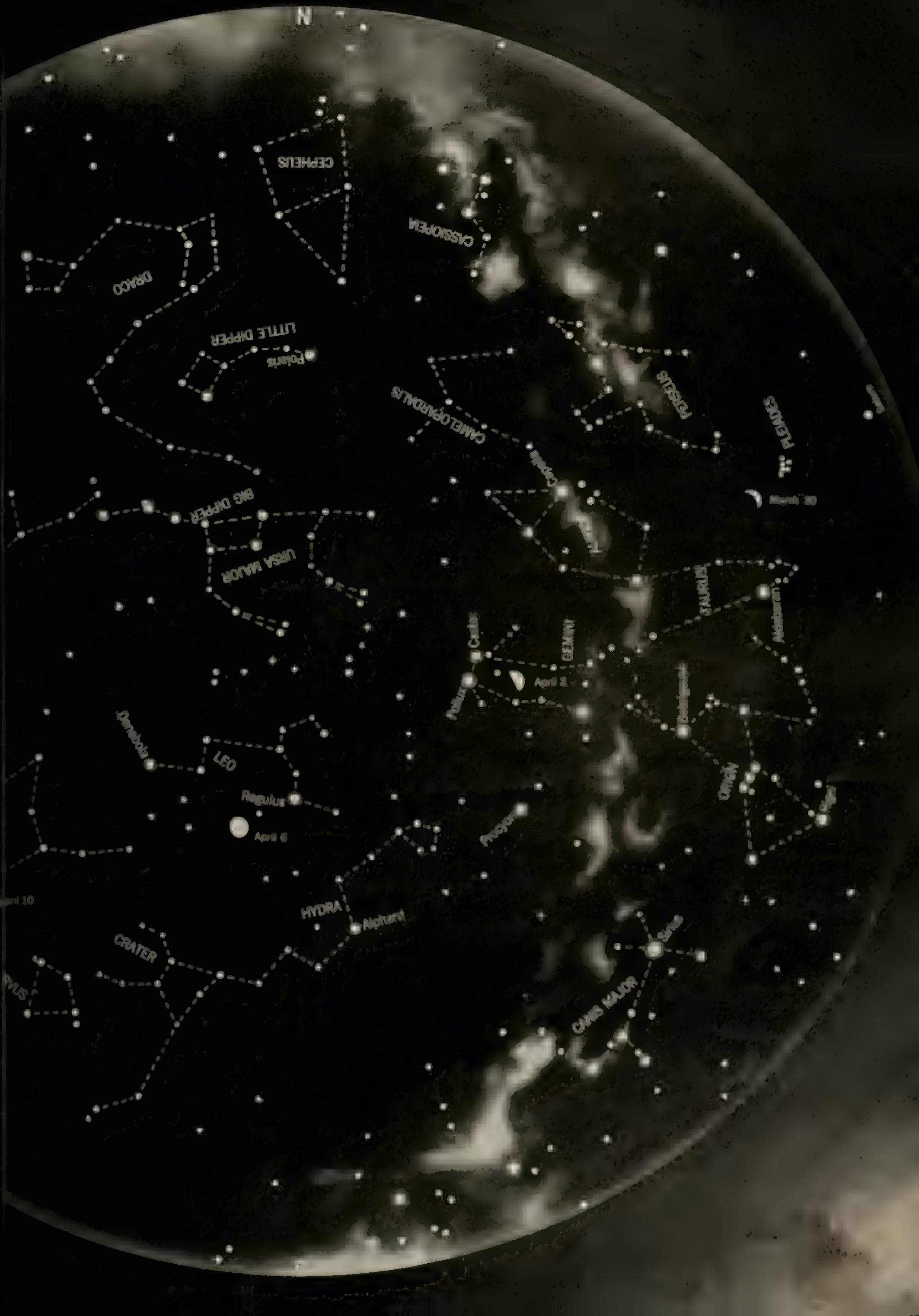
April 9: Mercury becomes stationary in right ascension and begins to move rapidly westward between earth and sun.

April 14-15: The moon again moves close to Jupiter and Antares in the morning sky. On the 14th, Antares is just to the left of the moon, Jupiter above and to the left. On the 15th both are some distance to the right of the moon.

Thomas D. Nicholson

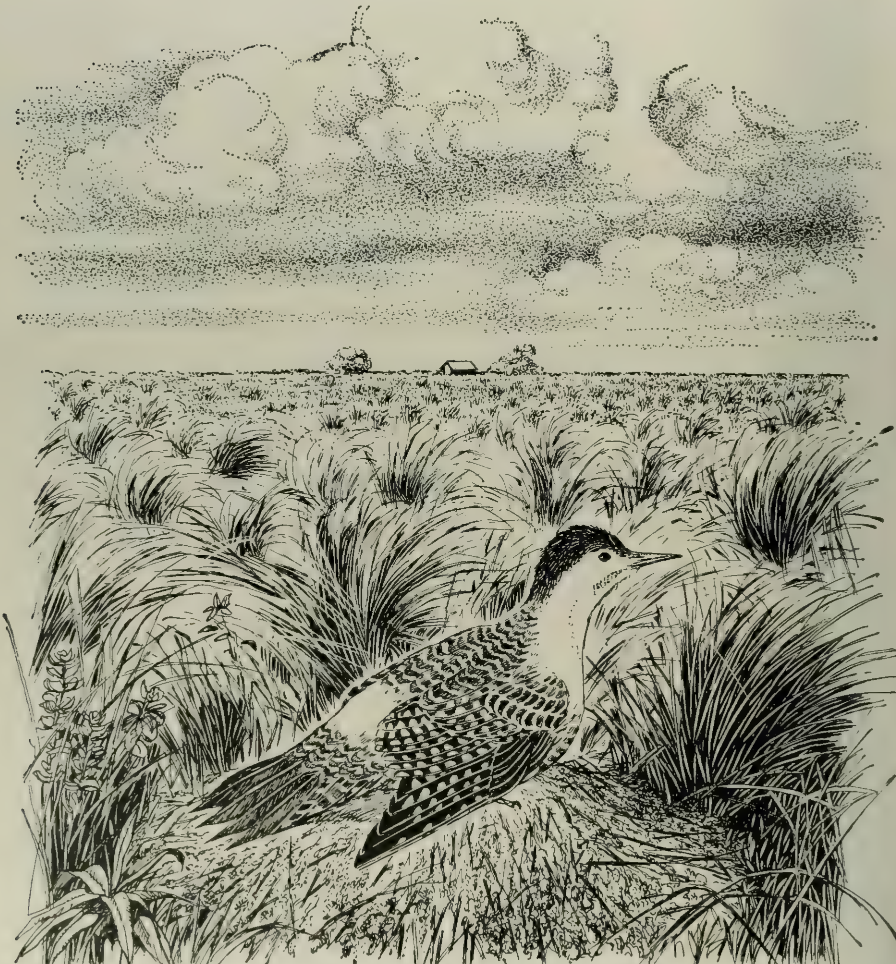
★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky. The map is for 11:25 p.m. on March 15; 10:20 p.m. on April 1; and 9:25 p.m. on April 15; but it can be used for about an hour before and after those times.




N
CEPHEUS
CASSIOPEIA
DRACO
LITTLE DIPPER
Polaris
CAMELOPARDALIS
PERSEUS
PLEIADES
Capella
March 30
BIG DIPPER
URSA MAJOR
TAURUS
Aldebaran
GEMINI
Castor
Pollux
April 2
Betelgeuse
ORION
Rigel
Denebola
LEO
Regulus
April 6
Procyon
ril 10
HYDRA
Alphard
CRATER
RVUS
Sirius
CANIS MAJOR

WOODPECKERS WITHOUT WOODS

by Lester Short



The campos flicker of South America

Man and climate are continuously eliminating forests, but some woodpeckers survive this habitat destruction by adapting to life on the ground

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A drum roll of staccato knocking uddenly erupts from somewhere bove, piercing the quiet of a small ood. The sound fades just as uickly, and the forest silence reurns. Again suddenly, with what eems a hint of impatience, the eries is repeated. While the source difficult to locate, the identity of he drummer poses no problem. A oodpecker is on the hunt. Pecking way in quest of insects hidden uner the bark of some tree, with a nisel-tipped bill suited for the purose, the woodpecker's rapping is a miliar sound wherever there are ees.

Among the tree-dwelling birds, ne woodpeckers are appropriately onsidered specialists par excellence. heir feeding apparatus—bill, ngue, skull, and associated muses and glands—and their locomor apparatus—toes, legs, muscles, nd tendons—along with other arts of their anatomy have rough the course of their evoluon become modified for a life of raging, climbing, and nesting in ees. Thus, it is perhaps surprising learn that within such a specialed group there are species that ave partly or fully abandoned a e in the trees for an existence on e ground.

Although such well-known spees as the North American flicker, *olaptes auratus*, and the European reen woodpecker, *Picus viridis*, e among those that have evolved artly ground-living habits, the asciation of woodpeckers with trees so firmly entrenched in most eople's minds that to discover that ome woodpeckers do their forag g on the ground usually proves urprising. Examples of woodeckers that nest in trees but feed on the ground are fairly widespread, however, occurring on all the continents except Australia and Antarctica, which have no woodpeckers at all. Included among these species are Bennett's woodpecker, *Campethera bennettii*, of Africa; Chilean flicker, *Colaptes pitius;* green-barred flicker, *C. melanochloros;* and the spot-breasted flicker, *C. punctigula*, all of South America; and various species of the green woodpecker group (genus *Picus*) of Eurasia.

If a woodpecker with partly ground-living habits seems an anomaly, then consider that three species of woodpeckers are completely terrestrial, not only feeding on the ground but nesting in it as well. The ground woodpecker, *Geocolaptes olivaceus*, of South Africa; the Andean flicker, *Colaptes rupicola*, of the northern Andes Mountains; and the campos flicker, *C. campestris*, of the savannas and pampas of South America, have successfully evolved from arboreal ancestors into entirely ground-dwelling birds.

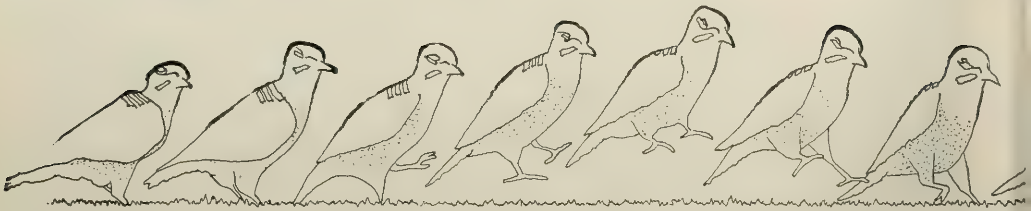
Tracing the evolutionary history of partly, and completely, ground-dwelling woodpeckers is a difficult process (as it is for almost all animals), and for certain species it is virtually impossible. But while there are some formidable problems involved, we know enough about the habits, morphology, and habitats of these forms to make some well-founded hypotheses.

Despite some accumulated knowledge of climatic changes that might have influenced their history, ascertaining the evolutionary background of the terrestrial woodpeckers is a problem because once they became terrestrial the species expanded their range to include all suitable, adjacent grasslands. Thus, it is difficult to establish in just what part of the Andes the Andean flicker, for example, might have initially evolved. Compounding this difficulty is the absence of closely related species of ground-dwelling woodpeckers. The ground woodpecker of South Africa is placed alone in the genus *Geocolaptes* and, although related to the widespread African genus *Campethera* (which includes such species as the Bennett's woodpecker and the golden-tailed woodpecker), no species or group of species of the latter can be regarded as particularly closely related to *Geocolaptes*. As evolutionary divergence is generally correlated with the time that has passed since the origin of the particular species, we can infer that the African ground woodpecker is an ancient species because of its wide divergence from related living, as well as ancestral, arboreal forms. Less ancient, perhaps, are the campos and Andean flickers, which conceivably share a common ancestor. These species, however, are quite different in appearance. They also differ considerably in their behavior from each other and from the related, partly arboreal Chilean flicker.

The modern species of ground-dwelling woodpeckers undoubtedly evolved prior to the advent of modern man, but human activities have probably assisted their adaptation to a terrestrial existence, and still continue to do so. Human-caused fires in the South African highveld and in the Andes of South America probably helped limit the distribution of trees in these regions. Of course man has had a far longer

Turning, hop & step

Bennett's woodpecker



history in Africa than in South America. His influence on the South American flickers can have occurred only after they were already fully terrestrial. Nevertheless, wood-gathering activities of Andean Indians have made for a more uniform, open habitat favoring the Andean flicker, and cultivation in grasslands may be favorable to all the ground woodpeckers. Indeed, Andean and campos flickers seem especially common around farm buildings, perhaps because of the increased nesting and roosting sites provided by man's activities; insects suitable for food may be more abundant as well.

On the other hand, tree-planting activity in open grasslands, such as the Great Plains of North America, may be retarding terrestrial adaptation in ground-foraging, but tree-nesting, woodpeckers. When the trees mature sufficiently in windbreak and woodlot plantings, nesting sites attract the partly ground-dwelling North American flickers, creating additional "edge" habitat that could not be utilized prior to tree planting.

Woodlots and village groves of trees in grasslands extend the normal habitat of tree-nesting, ground-foraging woodpeckers. By facilitating immigration and contact among populations of these woodpeckers, and by enhancing their habitat, conditions are provided that are exactly the reverse of those favoring enhanced terrestriality, namely isolation of populations and restriction of trees.

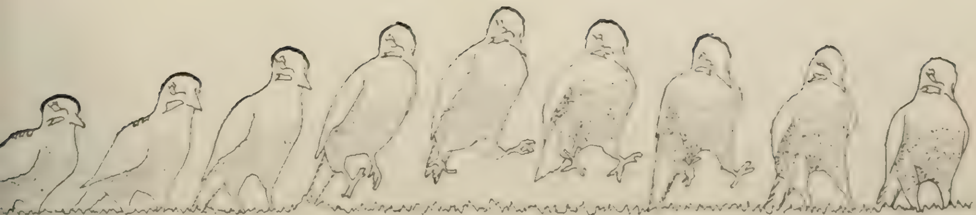
The campos flicker provides an interesting case of complete terrestrial adaptation with retention of the ability to nest in available trees or poles. This is of advantage to the birds of the low, flat pampas of northeastern Argentina where spring flooding from the rains saturates the soil and makes large areas unsuitable for nesting. Fence posts, telephone poles, or small groves of trees provide dry nest sites, and by using these the campos flicker can live in areas not otherwise available to it. Such adaptability is, of course, highly advantageous biologically. It further illustrates that terrestrial adaptation does not necessarily mean the loss of all arboreal habits.

Aspects of feeding habits, locomotion, internal and external anatomy, plumage, and behavorial patterns shed the most light on how it was possible for certain species of woodpeckers to use some of their ancestral habits and structures to successfully exploit a new evolutionary niche on the ground.

An important and revealing evolutionary aspect of terrestrial woodpeckers is their diet. All of the woodpecker groups to which the ground-foraging species belong subsist primarily on ants. Tapping and drilling with their bills, woodpeckers pick ants directly from the tree's surface or from beneath the bark. These woodpeckers feed upon various ants, including carpenter ants, many of which forage on the ground as well as in trees. In fact, some kinds of ants nest both terrestrially and arboreally. So it is not unexpected to find that ant-eating woodpeckers occasionally follow their prey from the trunks an branches of trees to their bases, an even down to the ground.

The evolution of ground-foragin habits in some ant-eating woo peckers may well have occurred u der such particular conditions the relatively recent increase aridity in many parts of the worl Woodlands in these areas unde went a process of prolonged co striction. Some of the restricte woodlands, containing ant-eatin arboreal woodpeckers, became eve more arid, with the trees widel scattered. Under these conditio woodpeckers able to forage on th ground would have been favore Gradually they came to feed mo on the ground. Those that did no failed to survive. Some of the d woodlands may even have di appeared, and in a few such regio the truly terrestrial woodpecke evolved. Several of the woodpecke that became specialized for grou foraging then evolved terrestri nesting habits that enabled them become independent of trees. should not be inferred, howeve that terrestrial woodpeckers sh trees. On the contrary, scatter bushes or eucalyptus trees may favored perches for singing or di playing, or during times of dange I have seen even the African grou woodpecker and the Andean flick utilize trees for perches, and some places, the campos flicker ne in trees.

All but one of the ground-fora ing woodpeckers have retain their ancestral ant-eating habi The exception is the Andean flick of the high puna grasslands a hills of the Andes. There, at elev tions up to 16,000 feet, the Ande flickers probe, flick, and pick wi



heir bills in the manner of the ant-oragers, but instead of ants they btain various insect larvae grubs), especially those of but-erflies and moths. Ants appear to e scarce at such high altitudes and pparently do not constitute a ma-or food item of this woodpecker.

It should not be construed that round-foraging woodpeckers sub-ist entirely on ants the year round. Even during their breeding eason they may take other foods, nd this has been observed in arbo-al species as well. When not reeding, however, they may eat ther foods to a greater extent, es-ecially fruits and berries. The orth American flicker's ability to cate such foods is responsible for casional birds remaining quite r north in the winter, and even during snow. These ground-fo-ging woodpeckers are opportun-ts enough to take spiders and any sects they may encounter, even ough ants form their staple food uring most of the year.

The mode of locomotion em-loyed by ground-dwelling birds of l types is usually dependent upon e nature of the terrain and the ensity of vegetation. Broken ter-in and dense, low vegetation fa-r hopping, especially in larger irds. Level terrain, lacking matted, ll vegetation (such as suburban wns), favors walking.

The manner in which any wood-ecker moves about on the ground ffers, of course, from its tree-imbing movements. Typical tree-welling woodpeckers, however, of-n move along horizontally on anches in much the same way at terrestrial species move on the ound. Tree-dwellers progress orizontally entirely by hopping, which is also a basic method of movement used by the ground-dwellers. In fact, even the tree-climbing endeavors of woodpeckers involve a movement akin to hopping, for the birds hitch themselves up a tree trunk with both legs thrusting in unison.

Partly terrestrial woodpeckers, such as the North American flicker, Chilean flicker, spot-breasted flicker, green-barred flicker, green woodpecker, and Bennett's woodpecker, progress on the ground entirely or primarily by hopping. The nature of the terrain and vegetation at the edges of the woodlands to which these birds are restricted favors this method of locomotion.

Only the three fully terrestrial woodpeckers walk as a means of progression, and even these species differ significantly in the degree of walking or hopping. The nature of the terrain and vegetation of their habitat is again related directly to the proportion of walking versus hopping.

The South African ground woodpecker characteristically frequents rocky outcrops in the highlands it inhabits. It commences foraging on the ground only after first alighting on the rocks and retires to the rocks at any sign of danger. Hopping, therefore, remains the primary mode of locomotion in this species as it is probably more advantageous than walking when it is feeding amid the rocks where the terrain is rough. When in other types of terrain, however, the ground woodpecker does walk as a means of getting around, but these instances are less frequent.

Just the opposite is true of the Andean flicker, which also frequents rocky outcrops and alights on rocks before beginning to feed, but ranges up to one-half mile away from the outcrops while feeding. Because of this, the Andean flicker spends more time on level terrain and so exhibits a greater degree of walking than hopping.

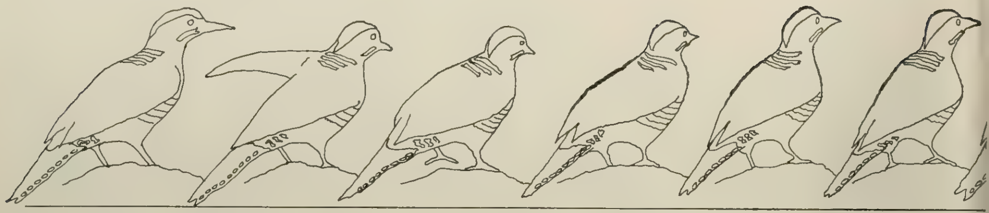
A complete shift from hopping to walking habits is not found in these two species probably because hopping remains advantageous for progression on rocky or otherwise uneven ground. The puna inhabited by the Andean flicker and the high-veld home of the African ground woodpecker have short grass or grass clumps spaced apart with open ground between, also favoring walking.

The campos flicker inhabits level country, but frequents termite mounds, anthills, and various raised sites. The grassy vegetation of its habitat is also often tall. This species, therefore, walks as its primary means of locomotion, yet hops to get around certain areas of its habitat.

Another correlative fact of locomotion in woodpeckers is that the three ground-dwelling species, which are able to walk, also nest usually in cavities excavated in the ground. They are thus free from a dependence on trees. The fully hopping species require trees for nesting purposes.

Thus woodpeckers have remained sufficiently plastic to evolve the walking habit essential for successful adaptation to [illegible]

Two steps & hop Campos flicker



grasslands, despite their hopping mode of progression in trees, and despite even their specialized, hoppinglike climbing habits. Having evolved the walking habit, ground woodpeckers have not discarded their ancestral hopping habit, but have retained it for use in those circumstances in which it is more efficient than walking.

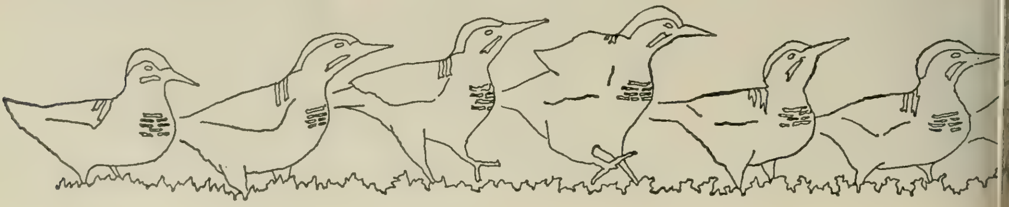
Woodpeckers are highly modified internally for "woodpecking." Of course there are many degrees of arboreal, woodpecking specialization, with the greatest adaptive modification shown by such diverse forms as the three-toed woodpeckers, *Picoïdes*, and the magnificent ivory-billed woodpeckers (two species of *Campephilus*, the North American ivory-bill and the Mexican imperial woodpecker, are possibly extinct, except for a few pairs of the former in Cuba). In each case the terrestrial woodpeckers are related to groups that are not so highly specialized. Ground woodpeckers, however, did evolve from more arboreally specialized species. This is suggested by the relatively arboreal habits of the woodpeckers' nearest relatives, the wrynecks and the piculets, and by the fact that terrestrial woodpeckers do not form a closely knit, related group; rather each appears to have evolved independently from a different woodpecker ancestor.

Strictly arboreal woodpeckers have moderately heavy to very heavy strong skulls with two special features: an indented, incurved frontal area where the bone beneath the forehead curves inward at the base of the bird's bill and a broad-based, chisel-tipped bill. Ground woodpeckers have no trace of an incurved frontal area, and their bills, although somewhat chisel tipped, tend to be more sharply pointed and much narrower at the base, especially between the nostrils. The broad bill of an arboreal woodpecker often reduces the nostrils to a slit, with the broadened bill base probably forming a stable platform for the driving of the tip, preventing its slipping or breaking. Ground woodpeckers' skulls are also less massive, with a weaker bony ring around the eyes and a thinner bony plate between them. The bony projections about the skull, which serve as attachments for various muscles that "drive" the bill and support the head during "woodpecking," are also much less strongly developed in the terrestrial woodpeckers.

In contrast to the reduction of the skull mass, ground woodpeckers have perhaps the best-developed extensible tongues among woodpeckers, although it must be noted that their arboreal ant-feeding relatives also have well-developed extensible tongues. The bones supporting the tongue of the flickers and the green woodpecker are very long, curving around the skull, over the head, and even out onto the bil into a nostril beneath the outer covering of the bill! These bones are controlled by various muscles tha can force the tongue far out from the tip of the bill. The tongue itsel is lined with fine barbs and coated with a sticky, gluelike substance that trickles onto the tongue. The salivary glands producing the sticky fluid generally are more massive in these woodpeckers than in the arboreal species. The tongue can extend as deep as two inches or more into the corridors of ant colonies, trapping numbers of ants ant larvae, pupae, and eggs on its sticky, barbed surface.

When the adults are feeding young, they are able to partly swallow ants, after having flicked them off the tongue, and to hold them in the saclike, enlarged esophagus that, in effect, acts like the crop of chickens. They are thus able to tak

Grassy terrain walk Andean flicker



reat numbers of ants at one time.
his is advantageous because it re-
uires fewer trips to the nest, and
ıe young are therefore less subject
, the danger of predators that
ight be attracted by the goings
ıd comings of the adults. The ants
ored in the esophageal sac are
gurgitated into the mouths of the
ung birds in the nest. The young
velop there for a time and then
ave. After fledging, they are fed by
e adults for a while, but they can
on accompany the adults to feed-
g sites. It must be a relatively
nple matter for the young to be-
me accustomed to the feeding
es and to foraging by themselves,
ıce no chasing or stalking of prey
required, and the food, namely
ts, is little varied.

O ther anatomical modifica-
ns of the ground woodpeckers re-
ıin to be established or fully un-
rstood. It appears that, compared
th their closest arboreal relatives,
und woodpeckers have longer
ls, which may be more useful for digging or probing into dirt, and they tend to have longer tarsi, which might serve better for hopping or walking. Differences in the use of the legs by ground woodpeckers are more apt to be reflected by differences in the arrangement and massiveness of leg muscles rather than by the relative size of leg bones. Some arboreal woodpeckers may use their legs in a manner requiring leg bones proportionally like those of ground woodpeckers, for there are diverse forms of tree climbing in woodpeckers. Hence the leg bones of certain arboreal and terrestrial woodpeckers may be essentially alike, although it is unlikely that they would be used in exactly the same manner.

Not only do ground woodpeckers differ structurally from tree-dwelling woodpeckers, but external differences are also evident. Terrestrial woodpeckers tend to have lost the often bright, marked plumage patterns of their arboreal relatives in favor of more subdued patterns, often including barring with brown and black above, spots or bars below. The flickers and African ground woodpecker are good examples. The more ground-foraging forms of woodpeckers are brown in each case, and their arboreal relatives are greenish. The ground woodpeckers also frequently exhibit "flash" patterns, such as white rump patches, bright yellow underwing and undertail surfaces, and bright colors such as yellow or pink *below*, rather than above. These patterns may serve as warning signals or as a means of communication with other individuals of the species while the birds are in flight, as well as during courtship and aggressive displays. When the birds are feeding, these markings are ordinarily not visible, and the dull pattern of their upperparts affords protection by causing the woodpeckers to blend with the earth and grass.

Among the most distinct and obvious of woodpecker color patterns are those relating to sexual recognition. Such markings are usually found on the bird's head. Their importance during the breeding season was documented by G. K. Noble's famous experiment with North American flickers during the 1930's. In this species the male has a malar, or moustache patch, which the female lacks. Noble captured the female of a mated pair, placed artificial malars on her, and released her back into her mate's ter-

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ritory. When she flew to the nest and was seen by the male, he attacked her viciously and unceasingly, driving her back and forth through the territory for a long time before she found sanctuary in a culvert. Noble rescued the bedraggled female, removed her moustaches and released her; whereupon she was immediately accepted by her mate as if nothing had occurred. The sexual recognition markings of woodpeckers are important not only in the breeding season but also during the rest of the year. Unlike most birds, woodpeckers appear to recognize each other sexually at all times. This serves in the dominance relationships of individuals that happen to meet, for males invariably assert dominance over females.

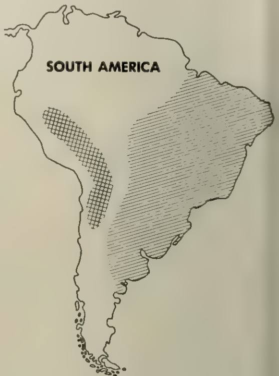
Head patterns are involved in species recognition as well as in sexual recognition. They may provide species-specific recognition signals that prevent individuals from mating with a species other than their own.

The tendency for reduced sexual markings in South American flickers and in the African ground woodpecker suggests that their sexual recognition involves not so much color markings as subtle behavioral signals. The gregariousness of these woodpecker species is in accord with this interpretation, for birds occurring in a close-knit group, instead of singly or in pairs, may become "familiar" with one another so that conspicuous markings are unnecessary. Not only are the markings less necessary for sexual recognition in these species, but they are also not needed for species recognition because most ground woodpeckers occur where there are no other woodpeckers, at least none closely related. Hence mistakes in mating are extremely remote and no special markings are necessary.

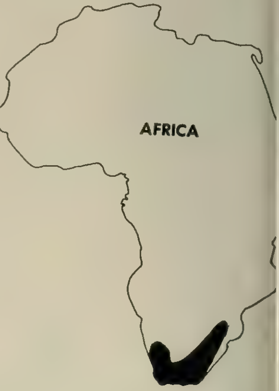
Ground-dwelling woodpeckers also show behavioral modifications that correlate closely with their adaptation to an open-country environment. Displays of these birds include flashing of colors and special movements like wing flicking, which can be readily seen, but only during the display. Ground woodpeckers also have voices modified to provide greater carrying power in the often windy, open terrain.

Compared with tree-dwelling wo
peckers, those living on the gro
have higher-pitched, yelping, rep
tive calls that can be heard for lo
distances. Because of similar ha
tats in the countries they inhabit,
unrelated African ground woodpe
er and the Andean flicker, which l
on different continents, sound v
much alike.

Most arboreal woodpeckers
solitary, territorial birds, pair
only during the breeding seas
or, if paired the year round,
maining only in loose contact a



The Andean flicker (small, shaded area) has adapted to
narrow band of high, open habitat. The campos flicker (larger area) occupies grasslands and savannas of South America.



The range of the African ground woodpecker is limited to the highveld region of South Africa.

ne young are raised. The more ompletely terrestrial woodpeckers re, on the other hand, among the ost social of woodpeckers. Anean flickers occur in groups of om three to fifteen birds, and genally nest in loose, but occasionally dense. colonies in earth banks, ad cuts, and rocky cliffs. The mpos flicker is slightly less social, it trios of adult birds are equently seen and two pairs may st in relatively close proximity.

An interesting habit of the Anan flicker is its burrowing into e adobe huts, usually abandoned it sometimes occupied, of the Inans during the Southern Hemihere summer. Interestingly, sumr is the time of greatest snowfall some of the higher reaches of the ides. This is because the rainy ason occurs in summer, and preitation in the form of snow quently results due to the high vation. The birds excavate roostz cavities in the adobe buildings ring that season. Individual ellings may accumulate 30 to 40 h holes over the years, and andoned, collapsing buildings ofi look as though they have been lled. Whitewashed buildings or se otherwise coated with preservae are not bothered by these woodckers.

The Bennett's woodpecker represts an intermediate stage between highly terrestrial and the typil arboreal woodpeckers. I studied s species in the lowveld (sanna) country of Kruger Park in South African Transvaal. ere, trees are evenly spaced, and woodpeckers feed both arbolly and on the ground beneath trees. While on the ground they p heavily, if not clumsily. At the tara Guest Camp in the park, I served five birds feeding regully on a small, well-tended lawn. ey also fed often upon ants in small trees around the grassy ea, as well as on the ground. hen disturbed on the ground, ey flew into a tree where they fored, showing no haste in returning the ground. Yet most of the foring of those five birds was acmplished on the ground. These rds probably made up a single mily party, for at least two had e markings of immature birds. As group African woodpeckers (gen-

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author of *High Trails West*

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era *Campethera* and *Dendropicos*) tend to remain in family parties long after the nesting period, in contrast to many woodpeckers elsewhere. Since the African woodpeckers are relatively primitive, and are related indirectly to the other ground-foraging woodpeckers as well as directly to the African ground woodpecker, it is important to note that long-lasting family groups must involve considerable social behavior. This factor in their ancestry was undoubtedly an asset to the Bennett's woodpecker and the African ground woodpecker in the evolution of ground foraging.

Like the Bennett's woodpecker, our North American flicker is dependent upon trees for nesting. Most of its foraging is done on the ground, however, and it can breed even where there are very few trees or cactuses (the southwestern form, called the gilded flicker, nests in saguaros and other large cactuses throughout the Sonoran Desert). Indeed, it is one of the few bird species breeding in every continental state and Canadian province.

The campos flicker lives on the open pampas of Argentina, and it is scattered throughout such country. It is especially common wherever there are termite nests, fence posts or telegraph poles of a size suitable for nesting, or trees. In favorable locations the nests of this flicker may be close together, almost forming a nesting colony, and in such instances the birds often share a common feeding ground.

The Andean flickers nest colonially or semicolonially, depending upon whether the nests are in an earth bank, a rocky cliff face, or an outcrop. In the latter case they burrow where they can, and the nests may be far apart. Nevertheless, the birds feed together in loose groups numbering up to eight or ten individuals. At the slightest disturbance, they bound up to a nearby rock and "laugh" a ringing challenge at the intruder. Even if not further disturbed, they will usually fly on a bit farther before resuming their feeding rather than return to the previous feeding site. On the ground they walk about, probing frequently into the dirt, jabbing and flicking earth to the sides as they dig out some insect. This species has by far the longest bill of any ground-feeding woodpecker, a though there is much variation i bill size among individuals.

The African ground woodpecke which is found only in the Republ of South Africa, issues its "laug ing" challenge from a rock pile c the highveld. Open, flat stretches highveld lack ground woodpecke which seem to need broken terra with rocks or deeply cut dong (ravines). Probing in the dirt b tween the rocks or on the highve close to the rocks, they secure gre numbers of ants. During the bree ing season in the Southern Hen sphere spring, pairs and trios birds are scattered about in roc places. They excavate a shallow bu row up to three feet in length into bank or road cut, then enlarge t end of the burrow to form a n chamber. Once successful in ne ing, they seem to return yearly the same site.

Thus, the ground-dwelling woo peckers have, with certain mo fications, capitalized on their anc tral habits and structures successfully exploiting a new nicl Their success is evident in th being a conspicuous and famil element of every grassland that th inhabit. That success can co from what would seem to be su an unlikely source demonstrates t fundamental evolutionary conc of preadaptation. This sim means that the side effects of t modification and reorganization structure and habits along a p ticular evolutionary course may directly prepare the organism quite another course as well. Unc certain situations, usually of stre the organism may strike out in new direction in which it perha meets with success. The side effe are "preadaptations" that best upon the organisms the potent for leading a partly or wholly c ferent way of life. Thus, certain the ant-feeding, tree-dwelling woo peckers were preadapted for an istence on the ground. Conditic in several areas where such woo peckers occurred were favorable a shift to terrestrial habits, and ir few cases complete shifts to terr triality occurred. The success ground woodpeckers attests to breadth of an evolutionary cou of specialization such as that "woodpecking."

Glen Conway just gave birth to an eight-year-old.

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ıan and helps people all the time. So when Glen
eard about Save the Children Federation in school,
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A Nice Place to Visit But...

by Isaac Asimov

ɪoon: Man's Greatest Adventure, y Silvio A. Bedini, Wernher von raun, and Fred L. Whipple. *Harry . Abrams, $45.00; 267 pp., illus.*

Not every book requires a reviewer to start with a physical descrip- on of its dimensions, but this one es. There's just no way to discuss it ithout first telling you that it is 12 ches wide, 15½ inches long, 1¾ ches thick, and as near as I can tell my bathroom scale, weighs nine unds.

It is not a book you can prop up on ur diaphragm while you're lying in d; not if you want to breathe. Nor it a book you can tuck under your m to read at odd moments while iting for a bus. You've got to put it a big, wide, empty desk, and then n over it.

But this book is worth the trouble takes to deal with it. Let me give u a few more statistics. It has 267 ges of the thickest, smoothest, best per I have ever seen in a book. It 278 illustrations, 143 of them in lor, most of them full page or more, l all concern the moon in one way another. There is even a foldout— 3-foot-wide detailed diagram of the ollo 11 flight to the moon and k.

Furthermore, it is quite impossible take the book, maneuver it into po- ion, and begin reading from page . Instead, you must start leafing. e eye is dazzled by the lavishly dis- yed, elaborately luxurious presen- ion of form, shape, and color that wns out the sober print.

The illustrations in the latter two- rds of the book deal with the rock- of the sixties that carried man to moon, and I believe that every oto-spectacular is included. There the picture of the Nile Delta as n from a height of 120 miles. In other photograph, Aldrin is walking the moon like a rectangular monster with an American flag on his head—serving as a reassuring note—and with his left foot skirting a tiny crater just large enough to hold his shoe if he cared to step in it. There are shots of individual lunar craters taken from vessels skimming the surface of our satellite, and a long, curving look at the Red Sea of a beautiful, blue earth, which looks more beautiful and more blue each time you return from staring at the bleak vistas of the moon.

It takes a while before you can manage to detach yourself long enough to read the captions to all those photographs and find out what it is you are staring at. Often that adds to the pleasure. When you look at a double spread and see the gentle gray curve of a world bisecting a small blue and white circle, you don't need to be told that you are seeing earthrise on the moon—but it adds to the interest when the caption tells you that this particular earthrise is the first ever seen, and that the occasion was the lunar circumnavigation of Apollo 8 on Christmas Eve, 1968.

There is more to this book, however, than the illustrations and their captions. There is a transcript of the conversations carried on by the astronauts on the moon's surface; a year-by-year description of the flights, both Soviet and American, that paved the way for the moon landing; a condensed four-page listing of all the important rocket flights through 1969; and a detailed description of the Apollo 11 and Apollo 12 flights.

In addition, there are three essays that spice up the book. Of these the longest and best is "Man and the Moon," by Silvio A. Bedini—the tale of man's preoccupation with the moon through the thousands of years of pre-Space Age history.

The moon as goddess, as calendar, and as mystic influence are all dealt with, and the illustrations of ancient artifacts and artistry serve as a teasing appetizer of archaic beauty preliminary to the full meal of wonders served up by today's technology. We look with awe at the worn and weathered smallness of Newton's original reflecting telescope on page 55 and at the rococo beauty of the instruments on succeeding pages.

There is a portion of the essay devoted to early maps of the moon and another (thank goodness for scholarly fairness) to the early fantasies of moon voyages. It is only just, after all, to be aware that writers of science fiction kept the dream of the moon's conquest alive through all the long years when orthodox astronomers tended closely to their fingertips. You will even find a reproduction of five of 1934's daily strips of—yes—"Buck Rogers in the 25th Century."

The second essay, by Wernher von Braun, is a relatively brief apologia for the space program—an apologia that is utterly unnecessary in a book that speaks so loudly for itself. And the third, by Fred L. Whipple, is an excellently organized and luminously clear account of the knowledge the moon landings have brought us so far, and what may be hoped for as a result of future trips.

But alas, even amid all the beauty of this book one can find cause for regret. Any book dedicated to a series of events that is unfolding steadily before our eyes must be out of date the day on which it is published. *Moon* is unable to give us the epic story of the near-disaster and the heart-stopping recovery of Apollo 13.

And consider the endpapers. The front endpaper is a detailed [illegible] by [illegible]-inch map of the nearside of the moon, with all the major features named. The back endpaper is a [illegible]

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tailed map of the far side—but only three or four features bear names. What a shame! Since that endpaper was prepared, the major features on the far side have received names honoring great and good men—not only astronomers and other scientific notables but even such far-seeing popularizers of space flight as Hugo Gernsback and Willy Ley. But the tyranny of time forces their omission and the sad blanks are the last thing seen, as one turns the back cover and closes the book.

Isaac Asimov is the author of more than one hundred books whose subjects range from science and science-fiction to Shakespeare and the Bible.

More Reviews

Man and Wildlife, by C. A. W. Guggisberg. *Arco Publishing Co., $12.50; 224 pp., illus.*

Hardly a month passes without the publication of a new book on man's relationship with wild animals or the endangerment of wildlife, which usually amounts to the same thing. Happily, these works reflect a growing public concern with conservation. Unhappily, not one of them chronicles any real reason for optimism about the future of wild animals. Most add a few more lines to our picture of the life-support systems upon which man himself finally depends.

Man and Wildlife's text consists of five profusely illustrated chapters followed by a continent-by-continent survey of national parks and refuges. Guggisberg's first chapter, well titled "Found and Lost," is an excellent review of the destruction of Steller's sea cows, spectacled cormorants, dodos, solitaires, and American bison. Succeeding chapters trace man's early dependence upon the chase and, with the rise of modern technology, consequent slaughter of seals and egrets, whales and otters. Finally, "Extinction" before man and by man are discussed and some of the efforts of "Man, the Preserver" are presented.

Guggisberg writes with a far-ranging pen, but in this short text much has had to be omitted. He is more successful in recording the history of human depredations than in discussing man's evolution as a hunter

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the debatable biology of exnction. The work might have profd from a discussion of animal popation dynamics and from a clearer lineation of the magnitude of huan population pressures as a threat wildlife. It may be that the effects direct hunting are proportionately eremphasized. In this book, as in any others on the subject, vanishing imals are too often seen as autonnous units rather than as parts of ecological whole.

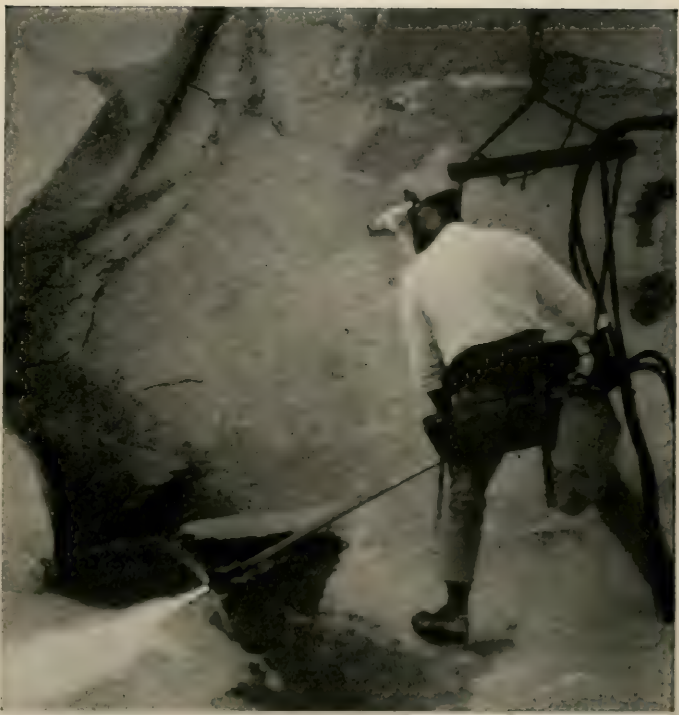
The author, rightly I think, sees nanal parks as the greatest hope of ving most species. Consequently, he votes about one-third of *Man and ildlife* to his universal park guide d attempts to indicate, in capsule rm, each park's principal plant and imal attractions. He also includes, thin each geographical section, lists recently extinct and endangered imals. The section is well conived, but poorly executed. The locans of the various parks and sancaries are marked on some twenty ps. However, they are located and picted only by numbered squares at indicate nothing of their shape d almost nothing of their size. Beles, the maps are so diagrammatic at they are nearly useless. No tography is indicated, and even macities are not shown, only national rders. Although park location numrs are keyed to adjacent lists of rk names, they are not keyed to the lividual park descriptions. But the gged reader who gets through these ts will find much of interest, inding a discouraging number of rks listed only as "planned" or "deed but not yet properly establhed." The list of United States enngered species is incomplete.

Man and Wildlife is a useful but breviated review of important asets of man's age-old assault upon d animals and incorporates an inesting but poorly arranged comidium of the world's national rks and wildlife sanctuaries. The iltrations are well chosen, however, l there is also a good index and erence section.

WILLIAM G. CONWAY
New York Zoological Society

E NATURE OF LIFE, by Lorus and rgery Milne. *Crown Publishers.* *.50; 316 pp., illus.*

rus and Margery Milne have been writing about life on this planet for enty-five years and have a score of oks to their credit. Almost all of m show the encyclopedic knowl



Another of those "impossible" views with a Questar

At historic Stone Mountain near Atlanta, a carver works on the Confederate Memorial. (See covering shot below taken with 50mm. camera lens, showing Questar Field Model mounted on Linhof tripod, Topcon camera attached, and worker indicated by black arrow.) The Questar photo, above, on Tri-X, 1/60 second, shows him in constant motion as he swings from a harness on the sheer granite wall, guiding himself with his feet and vibrating with the thrust of his powerful thermo jet torch. The photoengraving process permitting, you will notice such detail as his belt loops and a band around his left ankle. Photographs by Mr. and Mrs. Ralph Davis of Sarasota.

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edge and wide-ranging curiosity of these two zoologists who have alternated their teaching with travel. Now they have attempted to sum up and achieve a global perspective. The result is a thoroughly readable text liberally larded with photographs, both black and white and in color.

They try to cover an immense amount of ground, from the beginning of earliest primitive life, down through the continental drift, into the ocean depths, onto the mountain heights, and in between. Shortcuts are inevitable, and at times there is a sense of overcondensation. But in their foreword the authors frankly say, "In our overview of life on the continents and islands, in fresh water and salt, and of the steps shown by the fossil record toward modern times, we have simplified—oversimplified—to keep manageable the number of kinds for which historical patterns might be sought. We have emphasized these patterns among the familiar, the large, the conspicuous, the common, the colorful, and the scientifically meaningful. Most kinds of living things," they conclude, "are quite otherwise—unfamiliar, small, inconspicuous, uncommon, drab, or too little known to provide broad interest." So what we have throughout the book is a kind of review of the well known among the familiar plants and animals throughout the world, with just enough geologic and evolutionary background to set the stage.

The book ends with the one chapter where the authors summarize and reach conclusions. "The Spread of the Cultured Primate," deals with the rise of man, his cultures, his takeover of the earth and what it means and portends. The Milnes aren't optimistic. They finally say: "Every living thing is now involved to some extent because of the attempts of the cultured primate to support an ever-increasing population. . . . Given time, a fresh state of relative equilibrium will develop, although we may not like the outcome. It is sure to include the hardy, prolific pests and weeds." And, "The frantic fluctuations we see in the man-altered landscapes are marks of a chaotic community, one that has lost many of its important components and is in danger of destruction before new stabilizers can evolve."

Along the way to these conclusions, however, the authors present a widely varied panorama of relatively familiar life. Their firsthand accounts of Australia and South America reflect their special liking for those areas. So does their account of the Caribbean Islands. What we have, then, is a nat-

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ralist's travelogue, with emphasis on he colorful, the exotic, and the readly recognized. We know what they re writing about, and we also know hey are keeping it "popular." And vhy not? If the reader wants pro-undity, he can turn to the textbooks, ncluding those the Milnes have writen. Whether written to that purpose r not, this book was designed to be ooked at, browsed in—not studied. Ience all those colorful pictures, that rice. But the text, if one takes the ime to read as well as look, is inormed, accurate, well written and, as he authors say in fair warning, overimplified.

HAL BORLAND

LDABRA ALONE, by Tony Beamish. *ierra Club, $7.95; 222 pp., illus.*

The remote islands of the world—exotic, strange, and far removed rom the cares of the mainland—have aptivated the imagination of men rom earliest antiquity. One by one, owever, they have been occupied, hoogenized, and incorporated into the echnological world. Now there are recious few left that are in any way nique. It is little wonder, therefore, hat a threat to remote Aldabra, far ff in the Indian Ocean, rallied the vorld scientific community to its deense. The austere Royal Society of reat Britain and the National cademy of Sciences of the United tates successfully joined forces in ontesting the right of the British ilitary establishment to construct a et airfield through the heart of this nique atoll. To add one dubious sset to the Anglo-American military resence in the Indian Ocean, a comlete island ecosystem of inomparable value to science and the uman spirit would have been detroyed.

Aldabra, an elevated atoll made up f several islands surrounding a cenral lagoon, lies north of Madagascar nd southwest of the Seychelles Isands. For many reasons—primarily ts inaccessibility and the absence of eadily exploitable mineral wealth—it as been left alone throughout hisory. Today it supports a small settlenent on one atoll, but for the most art has been little visited and carcely disturbed by man. Some 60,-00 to 100,000 giant land tortoises, elated to those that have made the alápagos Islands famous, live there. t one time, green turtles were bundant, but these have been exploited and are now scarce. Great nesting colonies of seabirds, including the frigatebird, are found there, along with colonies of ibis and a rare flamingo. Aldabra has been an evolutionary center for endemic land birds including a flightless rail and a small kestrel. The vegetation and invertebrate fauna include many species that occur nowhere else.

All this is described in Tony Beamish's new book, a combination adventure story, travelogue, and natural history record. It brings the island to life, dramatizes the effort to save it, and highlights the values to be lost if the military had been allowed to pursue its dubious economies and questionable strategy to the usual tragic conclusions.

The book may not appeal to those who want a purely descriptive or scientific account of the island, but such individuals can pursue the references in the bibliography. Beamish has presented an intriguing record, however, of Aldabra, as it was in 1967 when the battle to save it was under way. The Sierra Club, through this publication, continues its splendid record of fighting to save the world's wild places.

RAYMOND F. DASMANN
International Union for the Conservation of Nature

THE BEST NATURE WRITING OF JOSEPH WOOD KRUTCH. *William Morrow & Company, $8.50; 384 pp., illus.*

By his own account, Joseph Wood Krutch probably knew "more about plant life than any other drama critic and more about the theater than any botanist," and the title of one of his books was *The Best of Two Worlds*. This volume, however, is a gathering of essays selected by the author from several of his nature books. In "best-writing" anthologies of this sort, some essays are bound to suffer in comparison with others, but the collection as a whole furnishes a good view of Krutch's scope and approach to the world of nature.

Krutch, who died last May in Arizona, emerged from the world of academic intellectualism that thrived in the 1920's. He was first and foremost a literary man who displayed a poet's skill with words. Intrigued by ideas, he shared the gentle obsessions and urbane wit of such humanist contemporaries as Mark Van Doren, Mortimer Adler, and John Mason Brown. When he retired from the classroom to take up the study of natural history, he retained the loquacious enthusiasm and cultivated style of a ra

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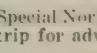

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tionalist who had survived, a veteran of all the congenital twentieth-century pessimisms.

He has often been compared with Thoreau, and like Thoreau, Krutch is highly quotable. His feeling for Thoreau is evident in his excellent biography of him, as well as in numerous of his essays. But the differences are profound. While Thoreau can rudely smash you between the eyes with concise crystals of his thought and experience, Krutch cannot be less than tasteful—at some greater length. Again, when Krutch writes about joy, it's seldom an emotional experience that he conveys, but a highly cultured and articulate observation about a feeling. He involves us on a loftier level than the gut, and his passion is of a very cool, disciplined sort—though no less genuine and eloquent for that.

He admitted that when he began his career as a nature writer, he was merely "trying his hand." The genre of the literary naturalist was a nineteenth-century inheritance indulged in by bright dabblers of the liberal arts, and it was a mark of Krutch's skill that he could reinfuse the tired forms of an obligatory exercise with meaning and care. But as his interest quickened, he found himself involved in something far more significant and deeply individualistic than an intellectual game. When he moved to the southwestern desert, the new world he discovered was manifestly as much in the eye of the beholder as in the geography.

His books and articles were numerous, he edited several anthologies, and he must have written at least as many introductions to the volumes of other nature writers as he wrote books himself. From the pessimism of his earlier philosophy, as documented in *The Modern Temper*, he seemed to be working toward affirmative conclusions as he thought and wrote in the desert. Ranging with the freedom of an amateur in the best sense of that word, Krutch could be shamelessly, deliberately anthropomorphic at times; yet he was a careful observer and meticulous writer. Most of all, perhaps, he exhibits himself in these essays as a genuine transcendentalist, in the sense of trying to relate his own experience to life's larger questions. In his rational, gracious way he shared his best with an age.

I particularly enjoyed the essays "The Civilized Animal," "Man's Place in Nature," "Wilderness as More Than a Tonic," and "Conservation Is Not Enough." These four alone are worth the price of the book.

John Eastman

We Talk, You Listen, by Vine Deloria, Jr. *The Macmillan Company, $5.95; 227 pp.*

As expected, this sequel is a more provocative charter for action than Deloria's first work, *Custer Died for Your Sins*. Serious without being a vacuous diatribe, it levels a polite broadside against persons "interested" in Indians. It has the same witty style—punctuated by poignant episodes drawn from the author's personal experience—that led to the wide appreciation of his first book.

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ment of its symbols. Strengthened by fear, white America increases its suppression of ethnic and cultural groups. Deloria regards this repression of minority groups as only accelerating a tribalization of American society—a way of life once uniquely Indian but now embraced by various "power" movements, as well as by the Woodstock Nation. In explicating this theme, Deloria also treats us, for the first time, to an Indian's often profound interpretations of recent news-making events in America.

Deloria acknowledges that our understanding of the tribal world is limited by the complexity of its basic structure and by our own misconceptions. In contrast to mainstream America, the organization of a tribe or group is centripetal and empirical. Many of our conceptions of so-called minority groups are predicated on erroneous assumptions that serve to worsen the relationships. White America has traditionally, and even constitutionally, approached these relationships on an individual rather than a group basis. The liberals' worship of the secular individual is antithetical to tribal aspirations. By looking at individuals, the pernicious "take me to your leader, if you don't have one, I'll give you one" syndrome only creates further alienation and lessened understanding as co-opted ethnic leaders become demagogues. Our perspective has also been jaundiced by viewing all ethnic groups in terms of Black-white relations, with Indians relegated, in political rhetoric, to the demeaning status of "others." As if this were not insulting enough, they are condemned for not exploiting the land, in short, for loving life.

Is there no hope? Deloria believes that there is—if his blueprint charting the course of this trend toward tribalization is followed. As a start, each tribe or group must be recognized, legitimized, and appreciated for what it is, not for what we want it to be. Each group must then build its own institutions with economic assistance for group development. New values, defined by the Indian philosophy that "man must live with other forms of life on the land and not destroy it," will replace a timeworn religion. The land will again be a source of group pride, rather than of individual wealth. Implementing the new values will necessitate a change away from the strategy of concentrating on single issues to the one used by Indians, working on multiple issues without priorities. In a nutshell, the political system will have to abandon its self-destructive gainful ways in favor of corporate development guided by group goals. In short, the newly emerging groups can learn a great deal from Indians.

Many readers will cursorily reject such a solution. Yet the challenge remains. Minority groups will not go away, they can't. Indians and other "visible" groups are not withdrawing from America; they actually want in. Indians see America wantonly exploiting Indian land and people. Their plight, their plea, is for control over their destiny, for self-determination. This is nothing less than the American dream: if it holds for individuals, why not for tribes, new and old alike?

RICHARD I. FORD
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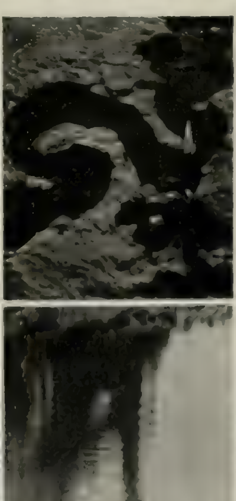

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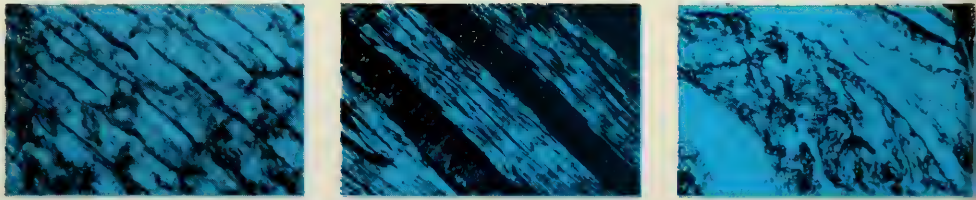
AN OCTOPUS TRILOGY *Continued from page 24*


SQUID OCTOPUS MONSTEF

In these micrographs, sections of contemporary octopus and squid and of the 1896 sea monster are seen in polarized light. The bright portions in each are connective tissue strands oriented parallel to the plane of the section; dark portions are similar strands oriented perpendicularly. In the octopus, equally broad bands of parallel and perpendicular tissue alternate. In the squid, broad bands of parallel fibers are separated by very thin perpendicular regions. In the monster, fewer bands are visible, but there are two broad bands of parallel fibers with an equally broad band of more or less perpendicular fibers between them. This is the proof that it was not a giant squid.

sue patterns of the specimens under polarized light. The highly ordered fiber protein molecules oriented in the plane of the section doubly refracted the light and showed up brightly, while those that were perpendicular appeared black.

Now differences between the contemporary squid and octopus samples became very clear. In the octopus, broad bands of fibers passed across the plane of the tissue and were separated by equally broad bands arranged in a perpendicular direction. In the squid there were narrower but also relatively broad bundles arranged in the plane of the section, separated by thin partitions of perpendicular fibers.

It seemed I had found a means to identify the mystery sample after all. I could distinguish between octopus and squid, and between them and mammals, which display a lacy network of connective tissue fibers.

After 75 years, the moment of truth was at hand. Viewing section after section of the St. Augustine samples, we decided at once, and beyond any doubt, that the sample was not whale blubber. Further, the connective tissue pattern was that of broad bands in the plane of the section with equally broad bands arranged perpendicularly, a structure similar to, if not identical with, that in my octopus sample.

The evidence appears unmistakable that the St. Augustine sea monster was in fact an octopus, but the implications are fantastic. Eve though the sea presents us fron time to time with strange and a tonishing phenomena, the idea of gigantic octopus, with arms 75 t 100 feet in length and about 1 inches in diameter at the base—total spread of some 200 feet—i difficult to comprehend. Yet sti stranger things have been seen an reported in the sea. Melville, hin self a nautical man and an ex tremely careful observer of the na ural history of the sea, speaks i *Moby Dick* of "a vast pulpy mas furlongs in length and breadth of glancing, cream color." Remembe a furlong is an eighth of a mile, o 660 feet. There's something to thin about.

PART 3

In Which Bahamian Fishermen Recount Their Adventures with the Beast

by F. G. Wood

Do giant octopuses exist? Dr. Gennaro and I think it likely that the St. Augustine sea monster was just that. But we had only the partial remains of a dead specimen to consider. Surely if such creatures do exist, someone, somewhere would have seen one, even though they do dwell on the bottom and would presumably be found only at great depths.

In March, 1956, a year before I found the clipping in the laboratory files, I had been sent to West End, Grand Bahama Island, to survey that location as a potential collecting area for Marine Studios. After making inquiries at West End, I engaged the services of a local fishing guide named Duke. He was highly recommended and I soon learned why. Before we set out each morning in his Nassau dinghy I woul tell Duke some of the kinds fishes I wanted to find. Invariab he would take me to a locatio where, on going over the side wi face mask and flippers, I woul find the species that he said wou be there. His knowledge of loc waters was no less impressive tha the reliability of his informatio

One evening we had return

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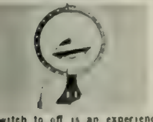

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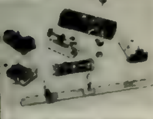

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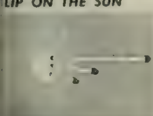

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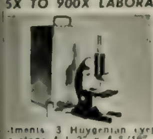

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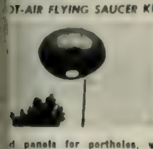

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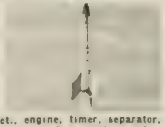

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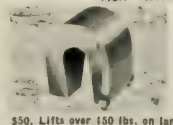

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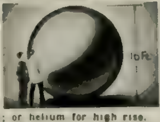

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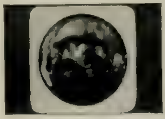

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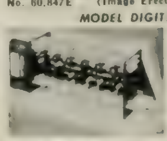

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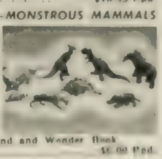

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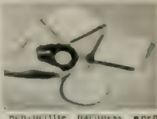

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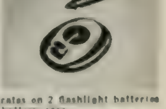

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from a satisfactory day of logging locations at which various fishes were to be found. We were sitting in his dinghy just off the beach. For some reason I remembered vague references to "giant scuttles" that I had heard years before when I was resident biologist at the Lerner Marine Laboratory on Bimini.

Scuttle is the Bahamian word for octopus—perhaps a felicitous blending of *cuttle* and a descriptive term for the manner in which octopuses slither across the bottom. All Bahamians were familiar with the small common octopus, but I had understood that giant scuttles, which seemed to be a part of Bahamian lore, were something else.

I asked Duke if he had ever heard of any giant scuttles around West End. Not surprisingly, he said that he had; then he proceeded to tell me when, where, and by whom they had been seen. While I don't recall the dates and names and places, I do remember that, according to Duke, the most recent encounter had occurred about ten years before. So-and-so had seen one off such-and-such key. And there had been, to his knowledge, two earlier sightings, again with names, approximate dates, and locations specified.

"How big did giant scuttles grow?" I asked. Duke, pointing to a small boathouse some 75 feet away, said their arms would reach from our boat to that building. He offered additional giant scuttle lore: they come into shallow water only when sick or dying; they are dangerous to a fisherman only if they can hold fast to the bottom and at the same time reach a small boat floating above.

Perhaps even a skeptical biologist could be forgiven for being impressed with this information. Anecdotal evidence is properly mistrusted, but the source must always be considered, and my informant had demonstrated his reliability in other matters. He had given me fairly precise data as to where, when, and by whom the giant scuttles had been encountered. And, certainly, if they indeed existed, the account of their behavior was reasonable enough.

A few evenings later I was chatting with the island commissioner. A native of Andros Island, he was a well-educated—and conservative— man. Octopuses were still on my mind. I mentioned my conversation with Duke, and asked him what he knew of giant scuttles.

Laughing, he told me of a time when, as a boy of about twelve, he had been fishing off Andros with his father and another man. They were handlining in 600 feet of water for silk snappers. His father had hooked something—the bottom, he thought at first. The line could be drawn up, but slowly as if it were hauling up a large object. When the end of the line came in sight, stil many feet below them in the clea Caribbean water, they could see a very large octopus clinging to it Detaching itself from the hook, th octopus came up and attached itsel to the bottom of their boat. The were very frightened, but finally th octopus released its hold and di appeared into the depths.

I asked how big the octopus was but the commissioner wouldn't say It had happened many years ago He would not estimate its size, bu it clearly was not comparable to th common shallow-water octopuse that everyone was familiar with.

What was the sea monster of S Augustine Beach? Is there indeed giant octopus in Bahamian waters As to the first question, Dr. Ge naro's examination of the tiss from the preserved specimen at th Smithsonian Institution indicat that it was not a giant squid, an probably not a whale or any oth kind of mammal.

That a huge sea creature of som kind washed ashore in Florida 1896 is beyond dispute. That it wa "a vertebrate animal, probably r lated to the whales," as Verrill nally opined, appears doubtful.

Initially, I found it difficult understand how the remains lay f weeks on the beach, unchange without further evidence of d composition. When I wrote of m puzzlement to Frederick A. Aldric director of the Marine Scienc Laboratory of the Memorial Unive sity of Newfoundland, and an a thority on giant squids, he replie "Frankly, I would tend to favor cephalopod identification of the m terial you mentioned and per t articles you sent. Cephalopod tiss particularly squid tissue in my e perience, is firm and does not eas

ecompose beyond a certain stage.
nd actually hardens and toughens
pon exposure."

There are also the reports of arms
n the remains of the creature.
)r. Webb had written to Verrill that
he stump of an arm had been un-
arthed, still attached, 36 feet long
nd 10 inches in diameter where it
as broken off distally. And would
Ir. Wilson gratuitously have made
p the details as to lengths and
umbers of appendages that he told
)r. Webb of seeing earlier? Even
hough Verrill apparently dis-
ounted these reports. they can
ardly be ignored.

As for the giant scuttle of the Ba-
amas. there is reason. at the very
ast. to keep an open mind. In the
ght of discoveries within the past
alf century of sizable. if not spec-
acular. animals both terrestrial and
quatic. no biologist can safely af-
rm that all such creatures are
nown to science. A large octopus.
ving at great depths. could par-
cularly escape scientific notice
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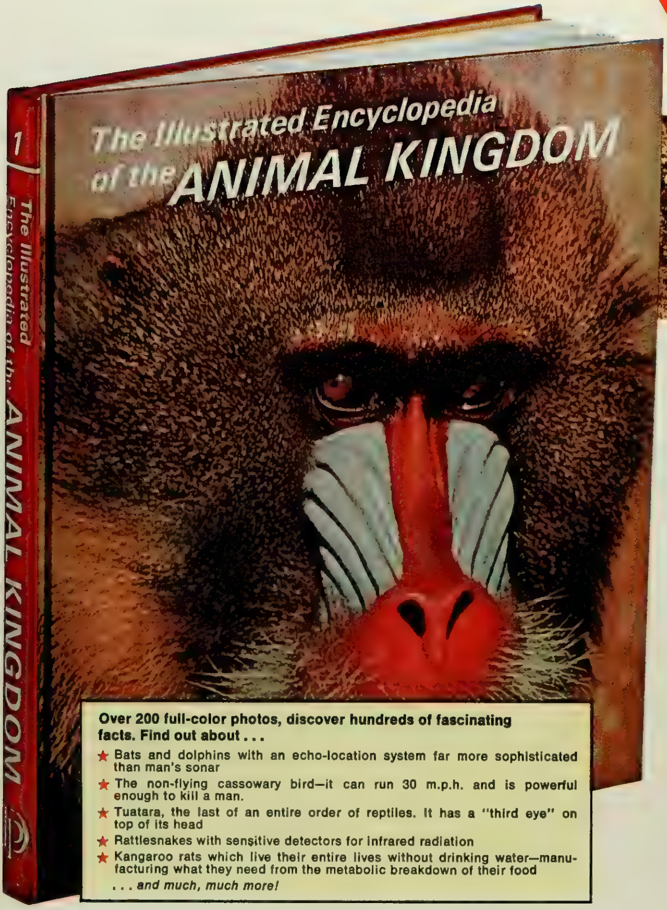
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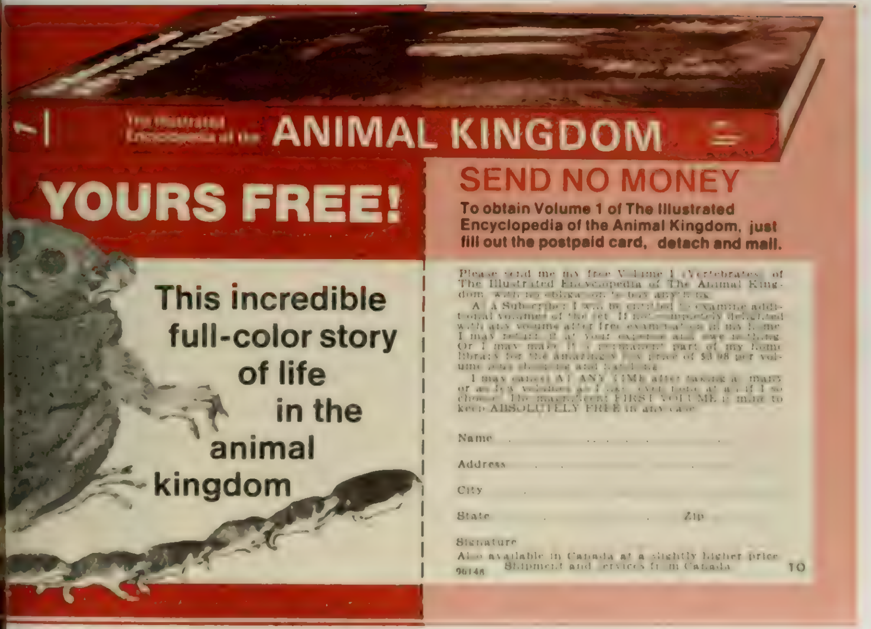

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The Journal of The American Museum of Natural History

Vol. LXXX, No. 4 April 1971

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Authors

Inspired partially by the loss of his money in the stock market, **Kenneth E.F. Watt** took a harder look at how economists and businessmen operate. What he found has led him to conclude that unless the world of money and profit soon recognizes some basic biological principles, there won't be a stock market around to blow his salary on. Watt, who obtained a Ph.D. in zoology from the University of Chicago, is a professor of zoology at the University of California at Davis. He has conducted ecological field work in Jamaica, Trinidad, Guatemala, and Fiji and is the author of *Ecology and Resource Management* and *Systems Analysis in Ecology*. Watt thinks big: he and his associates are presently attempting to create an ecological model of California.

Beginning as a graduate student working on the classic study of predator-prey relationships between wolves and moose on Isle Royale in Lake Superior, **L. David Mech** has been studying *Canis lupus* since 1958. A wildlife research biologist for the U.S. Fish and Wildlife Service, he is currently working on aerial telemetry tracking of wolves in the Superior National Forest in Minnesota. He has also radio-tagged and tracked leopards in East Africa. Mech obtained a B.S. in conservation from Cornell University and a Ph.D. in vertebrate ecology from Purdue University. He is the author of the recently published *The Wolf*.

An associate professor of eart science and assistant to the pres dent of La Salle College, **Brothe G. Nicholas,** F.S.C., has roame the world exploring caves. His fiel work has taken him to Australi Alaska, the Philippine Islands, th Swabian Alps of Germany, Malt India, Pakistan, Japan, Okinaw and England. Cave crickets have a ways fascinated him and have b come his special research interes The coauthor with George Moo of *Speleology: The Study* *Caves*, he has a Ph.D. in ecolog from the University of Notre Dam The F.S.C., *Frateres Scholaru Christianarum*, identifies his o der—the Brothers of the Christia School.

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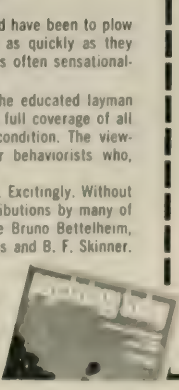

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Authors *continued*

Playing taped howls in a pack's territory and recording the responses is one way to conduct a wolf census. While engaged in this kind of wolf research in Ontario's Algonquin Provincial Park, **John B. Theberge** became interested in the differences between each wolf's howls. His analyses of sonograms of recorded howls uncovered an amazing range and variability of harmonics. His wife, Mary, proved essential to the making of the tapes. Her howling sparked immediate and vociferous responses from one of the wolves; Theberge's vocalizing fell on deaf ears. He is an assistant professor of ecology at the University of Waterloo in Ontario, and holds a B.Sc.A. from the University of Guelph and an M.Sc. from the University of Toronto. He has researched the ecology of rock ptarmigans in central Alaska and plans to study the role of aggression in regulating grouse populations.

C.H.D. Clarke, chief of the Fish and Wildlife Branch of Ontario's Department of Lands and Forests, is a dogged investigator of wolf folklore. Examining the extensive literature available, he has drawn upon his years of experience with wolves in the Canadian wilds to separate accepted fiction from little-known fact. His conclusions about rabid wolves and dog–wolf crosses explain many of the myths about wolf attacks on man that have persisted through the years. Clarke formerly served as a biologist with the Canadian Wildlife Service and has done research on musk-ox and ruffed grouse preserves in the Northwest Territories of Canada. He also served as an adviser to the Kenya Ministry of Wildlife and Tourism and was a wildlife consultant to the Temporary Commission on the Future of the Adirondacks. Clarke took his Ph.D. at the University of Toronto.

Muriel Schein spent a year 1967–68, studying the impact o modernization upon rural communities in Greece and became interested in the traditional role o women in older societies. Her husband, Seth, accompanied her, an his fluency in Greek enabled her t probe beyond the language barrier. An assistant professor of anthropology at Lehman College in New York, she has previously don field work among the Navaho Indians. Schein obtained a B.A. from Barnard College and her M.A. an Ph.D. in anthropology from Columbia University. She is coauthor with Sydney Diamond of *The Wast Collectors.*

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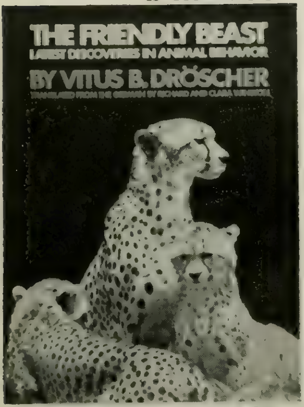
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Letters

A Warning

As a subscriber, member, and admirer of Natural History Magazine, may I make a friendly suggestion?

A word of caution . . .

Everybody is for a good environment. We're all for a viable ecology.

But we're getting pretty tired of reading about it. Day after day. Week after week. Month after month.

Foster A. Haley
Huntsville, Alaska

Everglades Revisited

I read with interest former Florida governor Claude R. Kirk's review of Patricia Caulfield's book *Everglades* that appeared in the January issue.

In it, the governor, a self-proclaimed conservationist, states that if forced to "choose between the deer of the Everglades and man, I would have to choose man." You can believe him. Show Governor Kirk a spot of daylight in the line of defense and he'll be through it like a roaring, red-eyed fullback to score a few more points for man against the environment.

The review also indicates that Governor Kirk opposed the Everglades jetport. It was not too long ago that Governor Kirk returned from a trip to Europe and told newsmen (I happened to be one of them) at Kennedy International Airport that he wanted to make Miami "the new gateway to the United States . . . the transportation hub of the continent" by building a supersonic airport in the Everglades.

Governor Kirk, who was still the elected head of Florida at the time, told about visiting the aircraft factory in Bristol, England, where the supersonic Concorde was being built, to "get our people [Floridians] stirred up and to get them moving faster" on airport construction. He said at the time that the Concorde was expected to fly in 1971 and that he was confident the supersonic airport would be finished in the same year.

"We'll be waiting with oran juice," he said with great enthusias

That orange juice was not intend for conservationists.

Al Carmicha
Port Washington, New Yo

Environmental Advertising

I object to the advertisement by t Standard Oil Company (New Jersey in your December, 1970, issue, whi describes their new technique for sei mic exploration for oil. The stat ment: "But fish were sometim scared and fled to quieter water Fishermen frowned" is misleadin and at variance with the facts.

Many thousands of fish have bee killed by the use of dynamite in sei mic exploration for oil. Further, hu dreds of recreational and commerci fishermen did not just frown. The bombarded legislators and gover mental conservation agencies with de egations, telegrams, and letters pr testing this careless destruction fish.

I also object to these sorts of piou declarations by industries that a among the worst perpetrators of i sults to the environment. It is almo as though they have just discovered is good public relations to espous concern for the environment.

Albert C. Jens
Mt. Sinai, New Yo

Acids, Chicken Gizzards, and Oil

Having been a member of the b of the state of New York for well ove forty years (retired), I might we wonder at law Professor E. F. Ro erts's artless rage at James Ridge way's, *The Politics of Ecology.* E sconced in his ivory tower, it seems me that the good professor owes mo to his students and to the readers Natural History than an endors ment of the status quo, no matter ho violently he disagrees with the "par noid" conclusions of Mr. Ridgeway He should have by this time di covered that there is a socioeconom approach to the law. (See Woodwe

·view of *Defending the Environ-ent,"* by Joseph L. Sax, same issue.)
I have not read the book, but ill—because it stands condemned by reviewer who fails to recognize that ere must be some semblance of uth in some of the points made by e author. What makes Professor oberts believe that certain interests not control government—federal, ate, county, and city? Take the ate of Maine, where I now reside. om whence come the pollutant ids and chicken gizzards that are imped into our Penobscot and Ken-bec rivers? Who spills oil along the cky shores of our seacoast and who lls our lakes? And why was it al-wed and why does it continue? es it not continue for fear of unem-oyment, for fear of not retaining vernmental office, for fear of not re-iving campaign contributions, ad finitum? And will it not continue as ng as men in our seats of learning e prepared to say, along with Pro-ssor Roberts, "Thus far, battered it unbowed, the system stands."

If we are honest with ourselves, we ll undoubtedly find that the truth s somewhere between the diatribe Mr. Ridgeway and the polemics of ofessor Roberts.

ALFRED FEINGOLD
Liberty, Maine

Beyond Civilization

I was absolutely stunned by the ar le "Beyond Civilization" by Paul hannan (February, 1971). Dr. Bo-nnan clearly belongs in the fore-ont of visionary thinkers and scien-ts. And don't we need them today! particularly liked, "We are now in e middle either of a crumbling civ-zation, or of one of those giant olutionary steps that we cannot see cause the goal is incomplete and uded, in the very atmosphere ound us." Would Dr. Bohannan be lling to give us his concept of the oal"?

GEORGE J. LANGMYHR, M.D.
Rocky Hill, New Jersey

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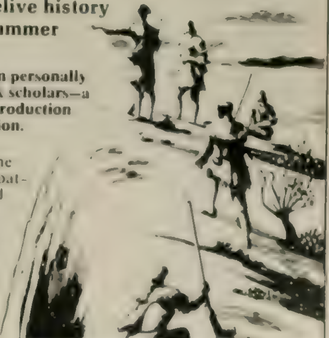

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Two of the most commonly discussed groups of problems in our society during 1970 were those of ecology and those of economics. But in all of this discussion, symptoms, rather than root causes, tended to be discussed. Consequently we can expect both groups of problems to intensify. Also, these discussions barely mentioned that the two groups of problems are fundamentally related and are both expressions of a small set of scientific principles. And the two words, ecology and economics, have a common origin in the Greek word *oikos*, "house" or "home."

This essay intends to point out just four of the many important principles that these two problem areas share. Hopefully, this will help correct the fairly widespread opinion that we have seen the worst with respect to both problems and that the future will bring us economic growth and a decline in pollution and degradation of the environment. One of the root problems is that the goals of economics and the goals of ecology are mutually exclusive if we maintain the current definition and mix of activities for the gross national product.

These four principles are:

1. Nothing that remains constant can grow at a compound interest rate forever. All growth processes are ultimately limited by saturation and depletion. Many people accept the validity of this principle, but most would be surprised at the variety of phenomena to which it applies and the shortness of the time before it begins to have a large impact on our lives.

2. The characteristics of any population, including man's, are determined by the age distribution of that population. What would surprise most people is the sensitivity of almost every political problem

Th

M. Tinkelman

ow facing America to the age com-
osition of the population. Children
ave generally been seen as an eco-
omic benefit, rather than a social
ost. In fact, excessive numbers of
hildren constitute a social cost that
n bankrupt even the richest
ociety.

3. Increasing specialization of
ny species, population, or individ-
l increases the vulnerability to
tinction if conditions should
ange. Any overspecialized indus-
y, city, or region is just as vulner-
le as a dinosaur, a passenger pi-
on, a blacksmith, or Nantucket in
40, before the demise of the
merican sperm whaling industry.
either individual size nor size of
e population is any protection
here were 80 million buffalo in
00).

4. In any competition, one does
tter than the others. Many factors
termine which competitor does best, but one important factor is the amount of product generated in a time period per unit of available input to the productive system. This principle applies whether we are considering flour beetle species or Japanese, German, and American automobile manufacturers.

What is some of the evidence bearing on these four principles?

The saturation-depletion effect shows up in four variants: resources, such as fish stocks, crude oil, or uranium ore can be depleted; populations can saturate the space available to them, either by themselves or in vehicles; markets can become saturated; and finally, the ability of the environment to absorb pollutants can be supersaturated.

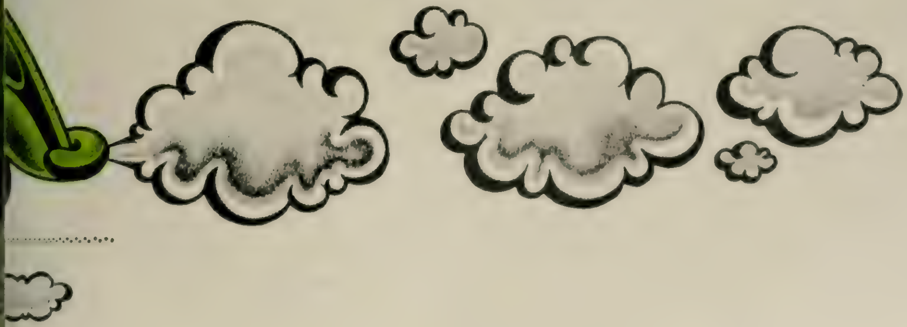
Perhaps the most significant form of resource depletion for humanity over the long run is depletion of stored-energy resources. Fossil fuels will be on their way to total exhaustion in 30 years or so if present trends continue. Western nations have advertised their life-style to all the countries of the world, without thinking through the consequences of future competition for dwindling energy stores. The worldwide annual consumption of crude oil, for example, doubles every ten years. The uranium ore situation is not promising. By the end of the century, with any conceivable mix of reactor technologies internationally, we will be using uranium ores that cost upward of ten dollars a pound—and the price will rise rapidly thereafter. This means that the price of nuclear power will increase sharply. The preceding statements assume that breeder reactors will be developed as rapidly as possible.

The saturation of space by humans or vehicles is a phenomenon

ong Arm of Biological Lav

Or, how Charles Darwin and his lot will inherit the earth

by Kenneth E. F. Watt



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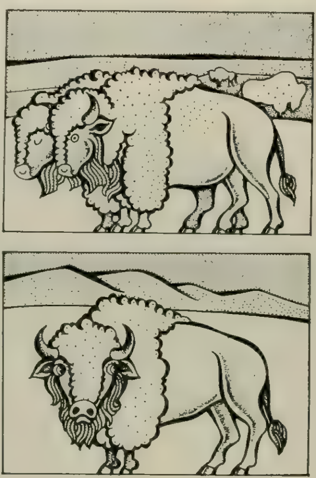
ern society. We now know that human beings will submit to less crowding than that previously found in New York, San Francisco, St. Louis, Boston, Cambridge, Chicago, Berkeley, Jersey City, Trenton, Washington, and Newark—all examples of cities that have experienced a net decline in population during recent decades. Also, we are coming to perceive the extraordinary effect of congestion on traveling time as our airports and highways become saturated. Mathematical models and statistical analyses show that journey speeds decrease rapidly as total saturation is approached. This is small comfort to travelers across the United States to Europe who spend $4\frac{1}{2}$ hours crossing the continent, $1\frac{1}{2}$ hours in a holding pattern over Kennedy International Airport, then 3 more hours waiting for permission to take off from the runway at Kennedy.


Great numbers of individuals do not protect a species from possible extinction. There were 80 million buffalo in 1800.

The high population densities of humans—whether in Calcutta, on the beach at Coney Island, in cars on California freeways, or on Manhattan Island—are not found in animal populations for two reasons. First, since animal populations do not use fossil or nuclear fuel, their

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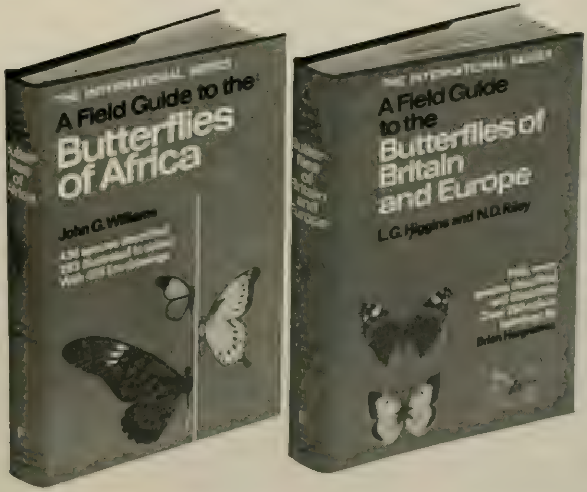
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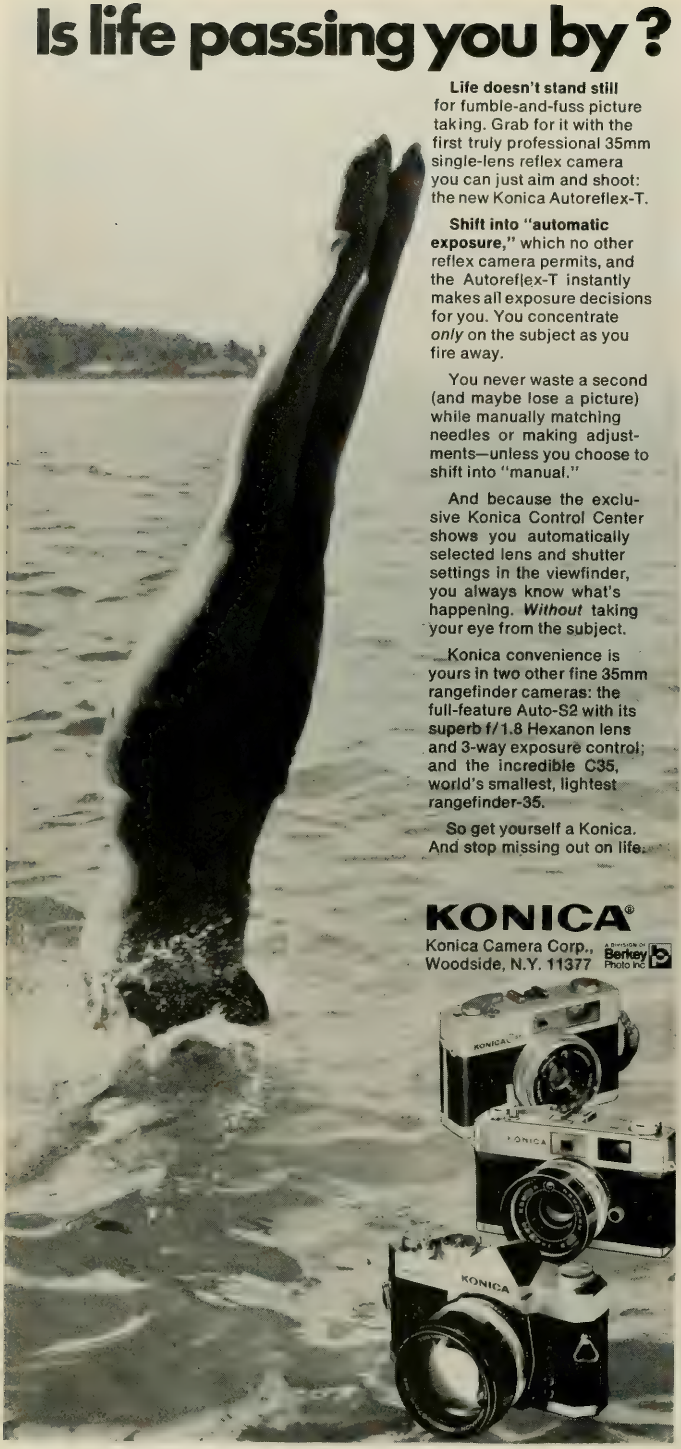

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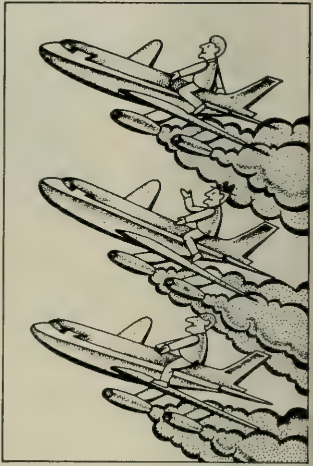
only source of energy ultimately is the sun. Because of the low efficiency of the photosynthetic process, and the low efficiency of conversion from plants to herbivores, and from herbivores to carnivores, animal populations can never become very large. Our large populations will, of course, drop precipitously if we are no longer able to supplement the solar energy input into our civilization with fossil and nuclear fuels at a high rate.

Second, because these populations have evolved adaptations to a relatively low availability of energy per unit area, they have had to evolve mechanisms to avoid crowding. One such mechanism is territorialism: each animal takes for itself the territory it needs to survive and defends this against intruding prospective competitors. Even where a habitat appears uniform, as on a sand beach, each animal has its own territory. If all the animals are about the same size, the territories will be about the same size. I observed a particularly clear example of territory arrangement in populations of horn-eyed ghost crabs at Poipu Beach, Kauai, Hawaii, where each crab burrow had an approximately equal area surrounding it.



Because seating capacity has for years far outstripped demand, airlines face big deficits.

There has been remarkably little discussion about the long-term imlications of total market satura- on. This is an impending problem r many industries, as evidenced y the widening gap between sales nd factory capacities and in- entories. It has become especially ramatic in the case of the airlines. Iany people believe that the cur- ent economic plight of the airlines eveloped suddenly, that it was due the unforeseen collapse of de- nand in 1970. This is not true. Fig- res from the Air Transport Asso- iation of America show that irline capacity has far exceeded emand since 1955. And that capac- y has been outstripping demand y a progressively widening margin the last few years. The annual oad factor fell from 58.0 percent in 966 to 56.5 percent, to 52.6 per- ent, to 49.9 percent in 1969. The nsequences of this proclivity to uild up unneeded capacity are im- ressive. The Air Transport Associ- tion recently predicted losses for e twelve major scheduled carriers f $123 million in 1970, $192 mil- on in 1971, and $279 million in 972. The full implications of this ituation are enormous, particularly nce the aerospace industry is al- eady in difficulty.

In time, industry and government nust realize that resource depletion, ngestion, market saturation, and ollution have sounded the death nell of the modern and historically nprecedented idolization of eco- omic growth. When that fact is iced, there is a remedy: we must rastically shift the mix of gross ational product away from activ- ies that use matter and energy oward services, education, and the rts. Also, we must begin not just miting population growth but ropping population size alto- ether.

Another developing economic ightmare, which has received little ttention in the rosy prognostica- ions for the 1971 economy, arises ecause the age composition of ociety is remarkably sensitive to mall changes in rates of popu- ation growth. The ratio of people n education-tax-consuming ages to hose in education-tax-producing ges will change rapidly in re- ponse to small increases in the rate f population growth. The magni- ude of this sensitivity has been lemonstrated in computer simula-

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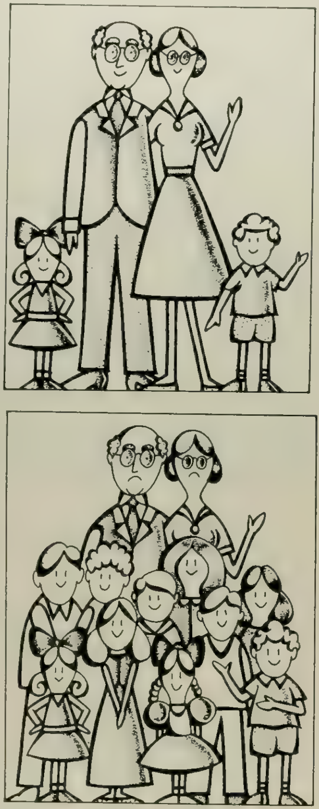
tion studies by Drs. Norman Glass, Theodore Foin, and the author. For example, an increase in the rate of population growth from 0 percent per year to 3 percent per year more than *triples* the education tax burden per taxpayer. Per capita expenditures for education in the United States increased by 101 percent from 1960 to 1968, while per capita expenditures for national defense increased only 59 percent in the same period. The implications of increasing the proportion of young people in the population ramify throughout the economy. Statistical analyses show the social cost of an increased rate of population growth above zero, and of an increase in the population density of a city. It can be demonstrated



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Glen Conway just gave birth to an eight-year-old.

's true. And the whole Conway family is delighted. len knows about helping because his dad is a police- ian and helps people all the time. So when Glen eard about Save the Children Federation in school, e wanted to do something. His parents decided it ould, indeed, be wonderful to sponsor a child. To ve their eleven-year-old a chance to learn how chil- ren in other countries, children less fortunate than ieir son, must fight for survival. And that's how ntonio Laverde came into their lives.

Glen and Antonio are separated by a lot more than ie miles between Long Island and Colombia. Antonio ves in one room. With eight brothers and sisters. oup made with potatoes and roots is his main meal. ou see, his dad only has the use of one arm. And ven though he works long hours at odd jobs, he still arns just five dollars a week.

Now, because of Glen and his family, much of that ill change. Through Save the Children Federation ie Laverdes will get an interest-free loan to buy ens. And the hens will lay eggs. Eggs to improve ie family diet. Eggs to be sold at market and increase ie Laverdes' income. And keep Antonio in school. or only with learning can there be hope. And some f the funds can be used to help make the community better place for all the children.

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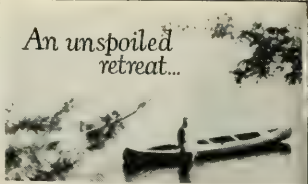
that the per taxpayer cost of living in different cities rises as the size of those cities increases. The immense costs of maintaining all levels of government in the next few years will create a drag on the growth economy and will raise searching questions about whether society can tolerate any more population growth. Hopefully, the most acute situation, New York City, will provoke careful thought elsewhere. A battery of legislative innovations will be required to deal effectively with population growth, including abortion legislation and punitive taxation for families that do not limit births to two children.

There have been a number of studies on the role of shifts in age distribution in natural populations. One of the most interesting was conducted by R. G. Green and C. A. Evans on the population structure of snowshoe hares. They found that the great fluctuations in hare populations could be traced to sharp reductions in the probability of survival of young hares at the peak density phases of the cycle. Interestingly, the best explanation for this sharp drop appears to be the stresses to which the mother was subjected. These caused hormonal changes in the mother, which were transmitted to the blood of her fetuses, and subsequently produced behavioral changes that impaired survival.

Because the human animal can make greater use of his mind than can other animals, birth control could preferably be the means for population regulation rather than allowing young to be born, who subsequently have a sharply lower survival probability due to excessive population densities.

Biologists know that increasing the degree of specialization in a species increases its vulnerability to disaster in an environmental change such as a sharp reduction in temperature. In her book *The Economy of Cities*, architectural writer Jane Jacobs argues that this same principle applies to cities. Her theory clearly applies at the moment to Seattle, which depends on airplane manufacture for its future. But why should Seattle's leading corporation so mismatch its capability with the evident social need for new technology that it wishes to manufacture the supersonic transport for



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irlines already plagued with over- apacity? Especially when society io desperately needs ultramodern, iigh technology intra- and inter- ity rail transportation? Clearly. orporations must learn the prin- iple so evident in biology, that ack of rigid specialization is the est guarantee of survival in an un- redictable environment. Govern- nent can help corporations to be ational, by subsidies to encourage etooling for trains, for solar or ther energy systems, or for mini- ars using batteries or steam.

One of the most interesting paral- els between biology and economics oncerns competition theory. homas Park of the University of hicago has shown with his ex- eriments on competition between pecies of flour beetles that one in- ariably replaces the other. The vinner in competition between two opulations is usually the species hat produces the greater density. ne way of interpreting this find- ng is to say that a population gains competitive advantage by max- mizing the production for avail- ble resources or, alternatively, by roducing a fixed product with inimum resources. Against this cological principle, the Depart- ent of Commerce figures on do- estic passenger car production lative to imports are significant. mports have increased their per- ent of the total car market from .6 percent in 1965 to 18.3 percent 1969. Recently, information on is competition indicates that the osition of the United States is not mproving. The relation of this to he flour beetle competition hinges n the lower cost of Japanese and erman labor. How can the escalat- g wages for U.S. automobile orkers, with resultant higher rices, maintain the number of orkers in the U.S. automobile in- ustry in the long run? One means vailable to the government for ontrolling this situation, other han rigid, foolish protectionism, is o impose wage and price controls n our automobile industry.

Perhaps economists and business- nen will reject as foolish the view hat ecological phenomena or prin- iples have relevance for the world f money and profit. If they do, it vill be of much interest to watch he future. ■

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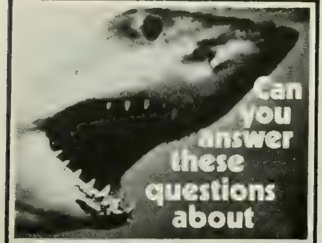

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True or false:

- A. All sharks are cold-blooded.
- B. Sharks are found only in salt water.
- C. Shark skin is covered with tiny teeth.
- D. Sharks are afraid of porpoises.

(answers below)

If the answers to these questions surprise you, you will find a wealth of other surprises in THE NATURAL HISTORY OF SHARKS, by Thomas H. Lineaweaver III and Richard H. Backus. The scuba age has overthrown many cherished misconceptions about sharks: It has long been proclaimed that sharks must turn over to bite. (This one goes back to Aristotle). And naturalists who should have known better have often pronounced the shark weak and harmless.

Lineaweaver and Backus, both associated with the Woods Hole Oceanographic Institution, have assembled a complete survey of all that is known about sharks today. They include their own observations and those of others, from William Beebe to Marco Polo. Their book is copiously illustrated with photographs and drawings showing all the major species of shark. And it includes—for the fisherman or amateur naturalist—a complete key to quick identification of any shark. The price of this fascinating volume is surprisingly low, only $6.95. Order your copy today.

(A. False B. False C. True D. False)

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A Naturalist at Large

Where the Wolves Are an How They Stand

by L. David Mech

As Ecological Man blinks his eyes, looks around, and starts to explore his world, he begins to realize that in his previous ignorance he has already damaged much of his environment beyond repair and has even wiped some of his neighbors out of existence. In taking stock of what is left, he has come across a most fascinating fellow citizen of his planet—the wolf—the wild progenitor of his familiar pet, the dog. And Ecological Man is now concerned about the fate of this animal, known also as the gray wolf, the timber wolf, and *Canis lupus.*

Concern about the wolf's fate stems from two main sources: the dark history of the wolf's extermination in many areas and the present prejudiced attitude of many people against the wolf. (As I write this, I am listening to a local radio program on which a middle-aged biochemist with a Ph.D. is advocating extermination of the wolf in Minnesota.)

While it is evident that the wolf will nevermore patrol the plains, mountains, and forests of much of its natural range, fortunately the species still exists in many extensive areas. This fact provides hope that man will learn from his past mistakes and will yet preserve the wolf as an integral part of his remaining wilderness areas. Let us examine the prospects in North America.

Originally the wolf inhabited almost all of North America north of the 20th parallel in southern Mexico. In general the wolf's only habitat requirement was the presence of suitable prey species: deer, moose, caribou, elk, antelope, mountain sheep, goats, bison, or musk-oxen. Thus the wolf ranged over every type of topographic and vegetative region on the continent, except deserts and barren mountaintops.

As settlers began pushing their way across the United States, however, they substituted domestic livestock for the large wild herbivores, and the wolves made the same substitutions in their diet. Feelings ran high, and a great war against wolves was waged. Every conceivable method of killing wolves was used, as well as some inconceivable ones—for example, removing the lower jaw of a trapped wolf and turning him loose among a pack of dogs. But the most deadly and efficient technique was strychnine poisoning. By 1850, wolves were gone throughout most of the east, and by the 1930's they had been exterminated from the west as well.

The original range of the wolf in the conterminous United States has now been reduced by about 99 percent. The remaining primary wolf range in this area consists of northern Minnesota and Isle Royale in Lake Superior. Upper Michigan may also support up to a dozen wolves, and rangers in both Glacier and Yellowstone National Parks have recently recorded the existence of a few individuals. There are also reports of small numbers of wolves in some western national forests, but it must be stressed that these are unconfirmed.

The subspecies of wolf thought to occur in Minnesota and Michigan

ncluding Isle Royale) is the east-
n timber wolf (*Canis lupus ly-*
on), and the Secretary of the In-
ior has declared that this race is
danger of extinction in the
ited States.

In Mexico, wolves are also con-
lered endangered. Although they
e legally protected in most states
ere, in 1964 Victor Cahalane of
e New York Zoological Society
thered evidence that their num-
rs were continuing to decline.
pulations at that time existed
ly in the mountains of western
ahuila and eastern Chihuahua,
d in the Sierra Madre Occidental.

Only in Canada and Alaska are
ere still large numbers of wolves.
Ontario alone, C. H. D. Clarke
cently estimated a population of
,000 to 12,000. Except for the
all eastern provinces, the only
rge areas from which the wolf has
en eliminated are southern Al-
rta, Saskatchewan, and Manitoba.

From Alaska, Cahalane received
imates of wolf numbers ranging
om 4,000 to 50,000 in 1964. In
70, James Harper of the Alaska
epartment of Fish and Game re-
rted that a conservative estimate
the number of wolves present in
e state is about 5,000. We just
n't know whether the disparity in
ures results from a decrease in
mbers of wolves or a difference
methods of estimating.

Clearly, however, enough wolves
e left in Canada and Alaska for
e population to be saved forever
ould man so decide. And this is
here attitudes become important.
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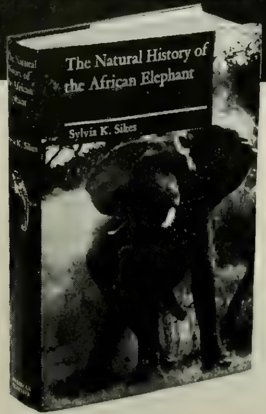

by SYLVIA K. SIKES

A definitive work on the African elephant, as an individual, a social animal within its environment, and a species exploited by man. Clearly and perceptively written by a distinguished naturalist as a result of her own field research, the book offers an original approach to anatomical study of one of the last survivors of Africa's dwindling fauna. In a brief concluding sketch, Dr. Sikes portrays the elephant in history, folklore, and mythology, and outlines ecologically sound and humane methods for the conservation of these magnificent animals both in the wild and in captivity. A selection from the preface and introduction of this book appeared in the December 1970 issue of **The Smithsonian**.

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frontier, and many frontier residents, who greatly influence the politics and government of their regions, view the wolf as a detriment to game herds and a direct competitor with man. Thus, bounties, poisoning campaigns, and general persecution, including hunting by aircraft, still exist in much of the wolf's present range. These can certainly jeopardize the wolf populations of Canada and Alaska, but public pressure by informed groups can reverse this trend.

A still greater threat to the wolves of much of Canada and Alaska exists, however: the prospect of settlement and exploitation of the remaining wilderness. Given the predictions of human population increase during the next few decades, it is not difficult to imagine a much more settled Canada and Alaska, with great dams, oil pipelines, and extensive mining, and with intensive reduction of caribou, elk, and moose herds. Destruction of the land and reduction of the prey populations will hurt the wolf far more than hunting, trapping, or bountying. None of this has to happen, of course, but the possibilities must be considered in assessing the wolf's prospects for survival over much of its present range.

What of the prospects for the wolf in the lower 48 states? Many people want to know that there are still wolves there, not just in Canada and Alaska. The answer is full of conditions and qualifications.

Prospects for the wolf are brightest in Isle Royale National Park and Minnesota. Isle Royale's population of 20 to 30 wolves is in harmony with its prey and is legally protected. As long as there is enough browse for the moose herd in the park, the wolves should prosper along with the moose.

In Minnesota, there is a primary wolf range of about 12,000 square miles, much of it in Superior National Forest. The number of wolves in that state is unknown, but I am currently working on a method that will make accurate estimates possible within a couple of years. Meanwhile, Craig Rupp, the forest supervisor, has closed the forest to the killing of wolves by any means. At this writing, this is the only protection the wolf has in Minnesota, except that poisoning, aircraft hunting, and snaring a prohibited.

Officials of the U.S. Forest S vice and the U.S. Fish and Wildl Service, however, are negotiati with the Minnesota Department Natural Resources on a plan th would provide for an ecologica sound management program for t wolf throughout the state. At pr ent, most of the officials are op mistic about the plan. Neverthele it is possible that the Minneso state legislature, which has gene ally been antiwolf in the past, m interfere with the plan in some wa

Wolves are legally protected both Michigan and Wisconsin, b it appears that protection came t late. The animal is considered e tinct in Wisconsin, although repo of lone individuals still circula And in Michigan the current es mate is that the few remnant wolv will soon be extinct. (A systema survey of the wolf population in u per Michigan is now under wa this should provide far better info mation about the situation than t scattered reports of the past.)

For the wolves reported fro Glacier and Yellowstone Parks, ar possibly from some of the wester national forests, an immediate ar concerted program is necessar Logic dictates that the subspeci of wolves occurring in these area presumably *Canis lupus irremotu* formerly thought to be extin there, should be declared an enda gered animal, for there must be fa fewer members of this race le than of the eastern timber wol which has been declared enda gered. This status should give im petus to any attempts to protect th wolf outside the parks, for exampl in any national forests where might exist.

Secondly, intensive efforts shoul be made to determine the extent the populations in these areas, bot in terms of numbers of wolves an area occupied. Special attentio should be given to determinin whether breeding and successful r production are taking place.

It has often been suggested tha certain wilderness areas from whic the wolf was exterminated shoul be restocked with wolves, and th national parks would seem to b ideal places for any such endeavo if it was determined that the exist

ig wolves are only lone remnants
stragglers.
Douglas H. Pimlott, a Canadian
thority on wolves, has explained
at "once trapping and hunting is
scontinued, wolves adapt to the
esence of people. . . . Before
ng the U.S. National Park Service
ould be encouraged to reintroduce
olves into Yellowstone National
ark and in Canada they would be
introduced into Banff and Jasper
ational Parks."
Suggestions have also been made
restock wolves in Michigan and
isconsin, which would seem to be
feasible plan if public pressure
ere great enough to bring it
bout. There are still large wilder-
ess areas left in each state where
olves could live without inter-
rence to livestock.
This last point is extremely im-
rtant, however, for outside of
ilderness areas, anywhere that
estock is raised, wolves can be
pected to prey on the domestic
imals. And it is unreasonable to
pect farmers and ranchers to tol-
ate such predation and to main-
in neutral or prowolf attitudes.
hey are going to raise strong ob-
ctions to the wolves, and these ob-
ctions will hurt the wolf's image
id any future restocking pro-
ams.
Therefore, restocking should be
tempted only in wilderness areas,
id wolves will have to be con-
olled if they venture into nearby
vestock areas. Otherwise we will
itness a rewakening of the same
ttitudes and programs that caused
e extermination of wolves from
oth stock country and wilderness
uring the first decades of this cen-
iry, and the status of the wolf will
e worse than it is now.
In summary, the wolf in North
merica, the victim of both "prog-
ess" and just plain persecution,
as been exterminated from about
alf of its original range on this
ontinent. With the Age of Ecology
pon us, public attitudes toward the
nimal are beginning to change,
hus increasing the chances of pre-
erving this fascinating neighbor of
an's in much of its remaining
ange and perhaps re-establishing
n it some of its former haunts.
Vhether or not this happens de-
ends on greatly increased public
wareness about the animal. ■

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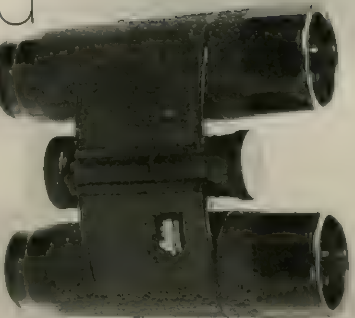

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Entrance, Twilight, and Dark

Within these three zones evolves the life of the cave

by Brother G. Nicholas, F.S.C.

The underground spaces commonly referred to as caves—barren and mysterious to the uninitiated—harbor so many undiscovered and little-known life forms that many biologists rank only slightly higher than amateur speleologists in comparative knowledge. The basic deterrent to a better understanding of the life processes of this underworld has been that the ecology of a cave encompasses not only those rooms and passages that a man can see with the aid of a lantern, but also the numerous minor passages extending for miles through fractures in the bedrock, the difficult-to-track subterranean streams, and the numerous openings, usually unnoticed by man, which small animals use to enter and leave the cave. The animal life inhabiting these regions of darkness and high humidity is so well adapted to the delicate web of a cave ecosystem that the tiniest crevice, the most minute puddle, or the smallest of guano deposits provides a microhabitat for some highly specialized creature.

But this underground laboratory is being steadily exposed by researchers who have donned head lamps and rope coils in pursuit of its secrets. These cave biologists are discovering the completeness of organization of cave animal populations and their relationship to the cave and the outer environment.

Upon entering a cave, the most obvious environmental character is the shift from the daylight at the entrance to the eventual total darkness beyond the entrance zone. Many cave animals live in this perpetual darkness and are normally never found in daylight. These are the troglobites, or true cave forms. An obvious difficulty in studying these faunal populations is finding them: troglobites are completely adapted to living in the absence of any light. Long sensory appendages, such as elongate antennae or hyperacute tactile organs that detect slight vibrations, or possibly even refined chemical receptors, make them aware of their neighbors and food sources. The biologist's presence is readily detected as he walks or wades into a cave passage, even if he proceeds very quietly. His focus of attention is limited to the narrow area outlined in the beam of his lantern, and the irregular walls and ceilings and the complex network of interconnecting crevices and cracks in the bedrock and flowstone shelter many species from his view.

As he moves about, searching for life, it becomes apparent that there are many minor variations within the supposedly constant environment of a cave. Crevices afford protection from air currents, which influence the ambient temperature. Water dripping from stalactites has a different mineral content from the water in a stream. The relative humidity is less in sheltered areas than in those parts of the cave inundated by seepage or waterfalls. Quantities of bat guano or other droppings on the floor and ledges provide nutrients not found in other parts of the cave and can, along with other decaying organic material, alter the acidity and alkalinity levels in an immediate area. Studies of these microhabitats, plus prolonged observation of those cave forms displaying a high visibility factor, have led to the conclusion that cave communities are as complex and differentiated as communities outside the cave.

In any ecosystem the behavioral patterns of individual species coordinate best with certain combinations of environmental factors. The site where an organism is usually found is referred to as its niche. What determines the precise niche of a species is a complex interaction both with the surroundings and with other organisms within a given environment. Since an organism may occupy several niches in the course of a lifetime, it is difficult to pinpoint any one niche as the permanent locus of a given species. *Typhlotriton spelaeus*, a blind salamander that is indigenous to the caves of Missouri and Arkansas, frequents cave entrances during its larval stages but as an adult, it retreats into the cave's dark zone. If the food supply becomes inadequate, however, the adults will travel out of the cave, remaining under rocks and in crevices near the entrance during daylight hours.

Bats, although not true cave animals, are extremely important to the life within. Leaving at night to feed, they return with the ingested materials that eventually, in the form of guano deposits, become the primary source of energy input for their diurnal environment. This is particularly true of caves in tropical areas, where it is not uncommon to find the floor covered with guano up to five feet deep. Even a layman can detect the myriads of harvestmen, beetles, cockroaches, spiders, flatworms, crickets, isopods, and other taxa that feed in and on such deposits. However, even in deposits that are apparently populated with dozens of species,

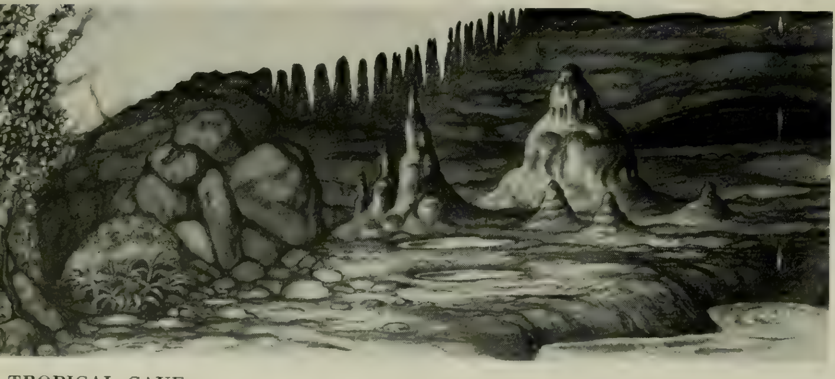
there are specific niches. Thus, flatworms are found in pools of water along the floor; amphipods and isopods in moist areas with perhaps no more than a film of water over the flowstone to enable them to move about; snails in mud deposited on the floor and walls; millipedes crawling through the guano; harvestmen and crickets moving down from the drier walls to prey on the beetles, mites, and other small arthropods feeding on the surface of the guano; and crayfish, fish, and salamanders swimming about in the streams flowing through the guano.

There is one significant difference between the organization of cave communities and that of other terrestrial types. In a forest or grassland community there is a definite stratification with an upper layer dominated by self-nourishing, or autotrophic, organisms: trees or plants that utilize sunlight for photosynthetic activity. This autotrophic zone is lacking in cave ecosystems, which are almost completely dependent upon external sources for energy. Caves do, however, have the complex consumer zone found at ground level in other biotic communities.

The stratification of a cave community is related to its environmental characteristics and to movements within the cave that reflect the periodicity and rhythmicity of its inhabitants. To gain a concise knowledge of a cave's stratification, it is necessary to recognize the different zones encountered in moving from the entrance to the inner reaches. The entrance zone, environmentally similar to the surrounding terrain, does, however, provide protection from extreme weather conditions. Its population may consist of small mammals, birds, amphibians, spiders, and other forms normally inhabiting sheltered areas. Man himself has used cave entrances as dwelling places. In tropical latitudes the populations at cave entrances tend to be permanent. In middle and northern latitudes these populations are usually transitory since the temperature drops during the winter. During adverse or severe climatic conditions the smaller organisms may migrate deeper into the cave if more moderate conditions are to be found there. To archeologists and paleontologists cave entrances are intriguing since men or animals buried or deposited there are more likely to remain preserved than those in more exposed areas.

Beyond the entrance is an area of more stable environment although it is subject to fluctuation in light penetrating from the entrance. This twilight zone frequently contains moss, algae, and other plant life. Many tropical caves with large entrances have a profuse flora in the twilight zone, but in northern latitudes the flora is normally limited to mosses and ferns. Populations in the twilight zone are extremely mobile. Individuals display little evidence of cavernicolous adaptation and the more active forage freely outside the cave if necessary. In a series of experiments in Mammoth Cave National Park, Kentucky, I marked about 4,000 cave crickets, *Hadenoecus subterranus;* provided that certain critical maxima of temperature and relative humidity were met, all the crickets migrated from the twilight zone at least once every three days. These crickets would leave the cave shortly after dusk to feed on detritus and plant material. All returned by dawn. Many crickets from the dark zone also migrated outside on a regular basis, adding to the traffic through the twilight zone.

This twilight zone displays the



Variations in light, temperature, and available food give shape to the three life zones found in caves, with each zone supporting a distinctive animal community. The troglobites of the dark zone have developed metabolic and behavioral economies to compensate for a meager, irregular food supply and low temperatures.

TROPICAL CAVE

ENTRANCE ZONE
Birds
Small mammals
Butterflies
Moths
Lizards
Scorpions
Spiders
Crickets
Snails

TWILIGHT ZONE
Bats
Harvestmen
Beetles
Cockroaches
Spiders
Flatworms
Crickets
Isopods
Arthropods
Millipedes
Mites
Salamanders
Lizards
Flies

DARK ZONE
Bats
Troglobitic species
(blind and white):
Fish
Crayfish
Amphipods
Isopods
Flatworms

The long-tailed salamander of the twilight zone is capable of leaving the cave for suitable habitats outside. It lives in moist crevices and pockets in the rock walls.

ecotone effect, peculiar to the interface between two diverse environments. The diversity of species is greater here than in either of the two bordering environments. In caves with small entrances and narrow twisting passages, the transition from the surface environment to the dark zone may be abrupt, and a true twilight zone is lacking, although the section of the dark zone closest to the entrance will reflect surface temperature. Such caves are difficult for man to enter, but from limited study it seems that troglobitic fauna are found close to the entrances.

The dark zone is the habitat of the true cave fauna and has the most stable population. As our study of caves has progressed—from that of exploration to discovery of cave-inhabiting species to a recognition of the complete cavernicolous ecosystem—we have determined that the phenomena of territoriality and community stratification are as operative here as in other terrestrial biomes.

In studying the population of two species of cave crickets, *Hadenoecus subterranus* and *Ceuthophilus stygius*, in Cathedral Cave, Kentucky, I found that although these crickets moved about the cave and even left it at night for feeding, approximately 90 percent of all individuals recaptured during a resting stage were in the same quadrat in which they had been marked. These one-meter-wide quadrats extended around the perimeter of the cave passage. The crickets were marked with a coded series of dots painted on their exoskeletons. Harvestmen, which had been similarly marked, were nearly always recaptured in their home quadrat. Attempts to mark and recapture the cave beetle *Neaphenops tellkampfi* were less successful, but observations of beetle colonies indicated that they also remained in the same quadrat.

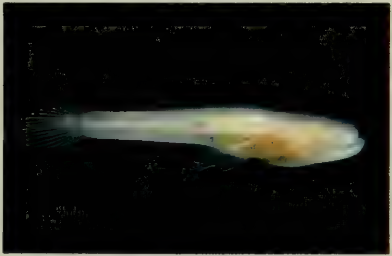
Just as an ornithologist expects to see certain species of birds at varying heights in a tree, so the cave ecologist expects various species within certain microhabitats of a cave.

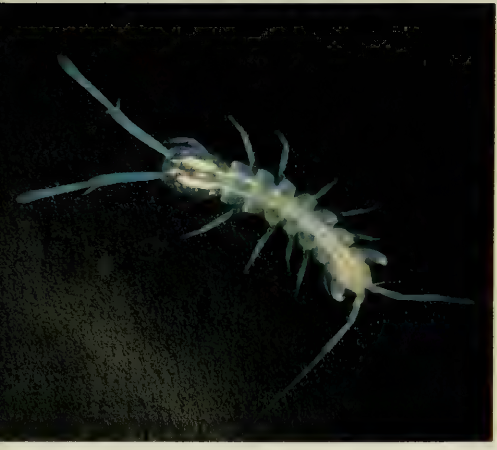
Bats, which hang from the ceiling or crevices close to it, are the most immediately apparent fauna. Some species cluster in masses that may number in the millions, for example, the free-tailed bat *Tadarida brasiliensis* in Ney and Bracken Caves in Texas. Others, such as the brown bat *Eptesicus fuscus* are solitary and may be separated from their closest neighbor by a distance of several feet. Bats, preferring a dry habitat, are not normally found on wet ceilings. In tropical latitudes bats leave the cave nightly to feed, and in cooler climates bats will also use caves as hibernation sites. Bat guano is one of the essential components of the food web in large caves, although cricket guano and organic material washed in from the surface compensate in caves where bats are absent. In such caves, crickets are found on the ceiling, particularly if there are indentations and small crevices. Where bats are present, the crickets are found farther down the walls. Spiders, harvestmen, and other forms that tend to inhabit drier habitats also occur near the ceiling and upper walls. Variations in temperature, air currents, and relative humidity, even though subtle, are significant enough to delineate microhabitats in which each species has its niche.

In the twilight zone, insects such as moths, wasps, and mosquitoes may be found temporarily inhabitating rough indentations of the upper walls or ceilings, and lizards can be seen scurrying along in search of crickets, flies, and spiders. Since many tropical caves have entrances surrounded by large quantities of flora, the communities within have an abundant food supply, even if no bats are present. Cockroaches and millipedes are found on the decomposing litter on the cave floor; in crevices along the walls are the tailless whip scorpion, *Tarantula palmata,* crickets, and large spiders that prey on the smaller fauna near the floor. Aquatic organisms such as flatworms, crayfish, and fish are naturally found at stream level, but in caves subject to periodic flooding these organisms can be found in pools above the floor. Precipitation of limestone from water seeping through the ceiling and walls results in the formation of rimstone dams. These may be ten to twenty feet high and located high above the normal stream level. In the Rio Camuy Valley caves of western Puerto Rico there are several rooms approaching 200 feet in height. Halfway up the sides of these rooms are pools that receive water from the Rio Camuy itself during flood season. Tree trunks and branches lodged in crevices 80 feet above the floor attest to the height of the floodwaters. Drippage from ceilings and walls into these pools compensates for any loss of water between flood stages. Here then may be found an aquatic community isolated for most of the year from the stream lower in the cave.

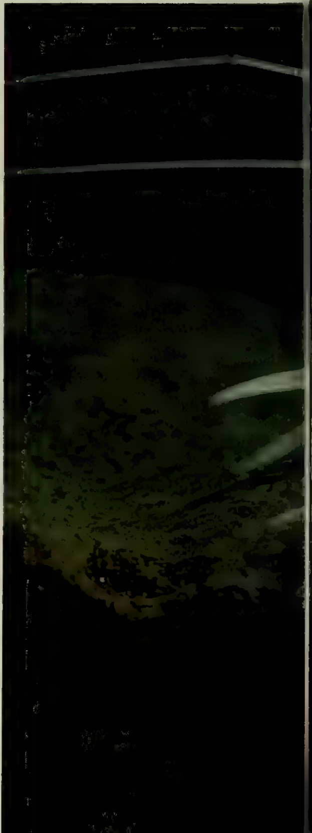
Stratification of populations within the dark zone is more precise since the environment is more stable. Along the floor in the mud and guano are springtails, beetles, and other small insects, millipedes and centipedes, snails, ticks, lice, and mites that have dropped from their host bats on the ceiling, and an occasional salamander. These populations, not abundant or immediately evident in most caves, are often overlooked by the casual visitor. Determining population density is difficult due to the irregularities of the floor. I have observed that concentrations of organisms are more evident near the juncture of walls and floor than in the middle of a passage, an indication, perhaps, of the tendency of most arthropods to inhabit enclosed spaces, even in the dark. In undisturbed caves that are frequently revisited by cave biologists, individuals of

Blind cave fish swim with smooth, gliding movements, creating a minimum of water agitation. This adaptation prevents any interference with vibrations emanating from prey.





A blind isopod, left, survives in the dark zone by consuming such varied fare as dead organic material, guano, protozoans, flatworms, and bacteria. At right, the cave crayfish, slower moving than its more robust surface relative, is able to fast between infrequent meals.



the same species and colonies are found in the same microhabitat, and it is tempting to think that the same organisms are being seen on each visit. In Cathedral Cave, Kentucky, which either I or one of my students visited at least weekly for a five-year period, there was observed on nearly every visit a lone long-tailed salamander, *Eurycea longicauda*, in a crevice approximately fifty feet inside the cave. Populations of *Hadenoecus subterranus* were also always found in the same areas, although the number of individual crickets composing this population varied. Individual bats banded in caves of West Virginia, Kentucky, and Texas have been recaptured for three and four years successively in the same section of the cave.

Large tropical caves display a distribution of communities different from smaller ones. Instead of a relatively uniform distribution of populations, they are concentrated in areas of bat guano. These caves, found in limestone belts of Central America, the Greater Antilles, northern South America, the Philippines, and New Guinea tend to have ceilings ranging up to 200 feet in height, almost vertical walls, and a low relative humidity even when a stream is flowing through them. Periodically, as one traverses the cave, there will be water dripping from the ceiling, but for the most part the walls are dry. Pools will occasionally be seen up to ten feet in depth, formed by rimstone dams. Bats roost in crevices and small potholes in the ceiling. If extensive formations exist, the droppings accumulate in these, rather than on the floor. Hence, ledges and pools up to 100 feet above the floor will have a heavy concentration of guano with a resultant proliferation of organisms dependent on it. Whole series of microecosystems thrive near these bat roosts, while the remainder of the walls are dry and devoid of life, except for an occasional cricket, cockroach, or scorpion. These large caves will sometimes have thick silt deposits trapped in the breakdown along the floor where many small forms of life can be found. As this silt is washed in from outside, most of the animals are surface forms. The present fauna in these and other caves may be merely preludes to large colonies of hitherto unknown species of cave animals.

As more and more caves are explored by scientists, the population dynamics of their inhabitants are coming under closer scrutiny. Zone by zone, an order similar to that found in surface life is being uncovered and understood. The variety of forms, and the ingenious adaptations they display, demonstrate that these holes in the ground, formerly ventured into only by fascinated speleologists, are indeed biologically productive and worthy of investigation by all.

WOLF MUSIC

By howling, wolves communicate their location, their identity, and even something of their emotional state. What they communicate to man is something else again

by John B. Theberge

Once we thought that birds sang just to make us happy. Not until 1920 did Eliot Howard teach us that by singing, birds were proclaiming territories, a shocking blow to our egocentricity. The story has continued to unfold, and we now know something about the subtleties of bird songs—that dialects appear in different geographical localities just as they do in the English language, that neighboring birds of the same species sing differently, and that one bird can recognize another by its song. Even the domestic fowl, which we have selectively bred for centuries to improve its meat but not its intelligence, gives a different type of alarm call when danger is coming from the air or from the ground.

But we know less when we turn to mammals. Their sounds, like those of birds, undoubtedly have some meaning. Essentially all shapes and sizes, colors and sounds have functions. According to Darwin, these have all been molded and fashioned by natural selection, and all have provided in the past, or provide now, an advantage to the animal.

Howling is a most dramatic animal sound. How does it assist the life of one of the most highly developed social species, the wolf?

I first became interested in this question while taking part in a study of wolves for the Ontario Department of Lands and Forests. Summer studies of wolves in forested regions are a problem because of the difficulty of merely locating and maintaining contact with them. But D. H. Pimlott, the director of the Ontario study, discovered that wild wolves will often answer tape-recorded wolf howls broadcast from a loudspeaker. This technique was so successful that field parties were outfitted with portable tape players, and became traveling wolf-minstrels. Our task was to put together a map of all the packs in the 3,000 square miles of Ontario's Algonquin Provincial Park.

Wolves came to our howls on many occasions, thus demonstrating that they can pinpoint the source of a sound with great accuracy. This may be important in reuniting individuals separated from members of their social unit during nightly wanderings. Perhaps it is fundamental to any social structure in wolf packs, for without it, wolves could only communicate through vision and scent. Over distances of a mile or more, pack cohesion may be impossible without a form of vocal communication. Wolves do howl when separated on the hunt, although we never documented howling when they were actually chasing prey.

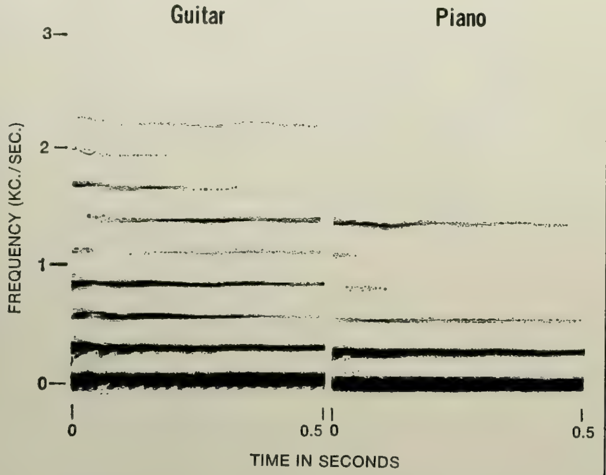
Later I was able to better document that "spontaneous howling" by lone wolves was associated with separation of individuals from pack members. I found a pack of four adults and three pups at the edge of a large clearing. On two mornings I observed single wolves returning to the pack. During the preceding nights, spontaneous howling occurred both from the stationary pups and from single wolves at various locations a mile or two away. When the singles returned, some howled just before they entered the clearing, others arrived unannounced. Each member's return sparked dramatic greeting ceremonies. The whole pack frolicked together in a tight group, tails vigorously flicking over their heads. This lasted only a few minutes; then the adult wolves lay down in the long grass and the pups resumed their endless play.

Other factors affected willingness to howl. Time of year was one; wolves responded more frequently as the summer progressed. Weather was another; if any rain, even a light drizzle, was falling, wolves rarely howled. Wolf trappers say that fewer wolves are caught on rainy nights. This suggests that wolves travel less in the rain—perhaps the explanation for the fewer howls.

The amount of time elapsed from a previous howl also influences willingness to howl again. Ethologists recognize a time lag between responses in many forms of animal behavior, and liken this time to the refilling of a toilet bowl with water after being flushed. In animals "action-specific energy" must build up before they will respond again.

The more we worked with wolf howls in our censuses, the more questions seemed to arise. Can wolves identify each other by their howls? Is there information coded in howls, and if so, what is it? Does some part of a howl trigger a response?

We knew something about the last question. Wolves respond to sounds other than live or tape-recorded wolf howls. Simulated wolf howls by humans work too, even poor imitations. No two humans howl in exactly the same way, but all seem equally successful



A guitar and a piano playing the same note sound different. When the sound of each is broken down into its component parts, as has been done in these sonograms, the reason becomes clear. The lowest line for each instrument is the fundamental frequency, the main sound we hear. The higher lines are the harmonics. Instruments differ in the number of harmonics and in their relative intensity (shown in the sonograms by the relative thickness of the lines).

eliciting howls from wild wolves. Nor must sounds always be particularly wolflike. Loggers in Algonquin Park reported wolves howling in unison with their chain saws. One summer we inadvertently conditioned a pack of wolves to respond to the slam of a truck door. Our usual nightly procedure was to stop on the highway at the same spot and play our recordings. We parked on a slope, often slamming the truck door when we got out. Eventually the tape recordings were superfluous—the slam of the door was enough to start the pack howling.

Isolated experiences such as these, while interesting, were not enough to provide any detailed knowledge of wolf howling. To learn when and why wolves howled, meant getting to know them well.

The opportunity to do this was provided by three captive wolves housed in pens at the Wildlife Research Station in Algonquin Park. In the summer of 1965 I selected one of these wolves, Big Gray, and took him three miles to an isolated area where he would rarely hear other wolves. I built a pen for him in a small clearing behind a long-abandoned ranger's cabin, and in mid-May, began my research. By playing howls of wolves with whom Big Gray had grown up, as well as howls of wolves he had never heard, I hoped to find some differences in his behavior, howling or otherwise, that would show he recognized individuals by their howls. By comparing Big Gray's behavior when he howled with features of his howl I hoped to find differences in the sound that might convey information. By his response to various frequencies, I hoped to discover if a particular note or combination of notes would trigger a response.

But Big Gray refused to howl. All through May and June, night after night at half-hour intervals, I played tapes or howled myself from the cabin window, out of sight of the wolf, and heard no replies Then at the end of June, my wife Mary, joined me at the cabin. O her first night there she howled. Bi Gray responded immediately. could not believe it. She howle again. He answered. They repeate the performance all night, but if played a recorded wolf howl o howled myself, Big Gray was silent Big Gray did not know Mary an had never heard her howl before Yet Mary's howl worked.

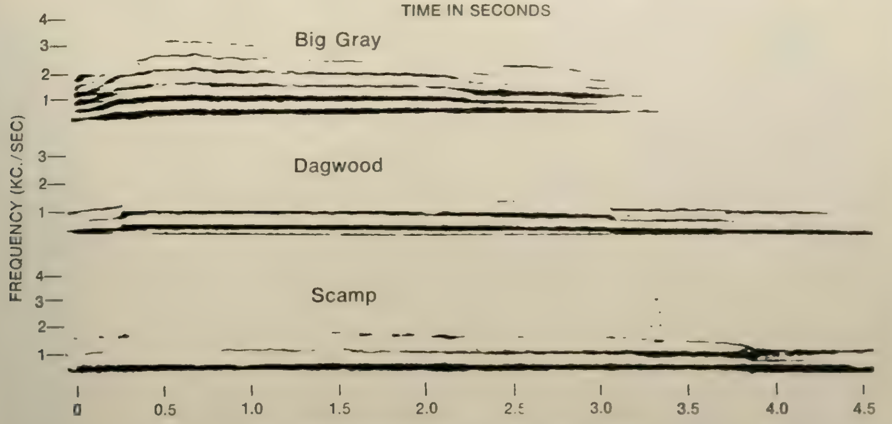
The next night we tested Bi Gray by howling identical notes, above middle C on the piano. Agai Big Gray consistently responded t Mary, but not to me. So, no trigge ing frequency was involved in stimulating his reply. Although w never found out why he was s enthralled by Mary's howl, we di learn how well he could discriminate.

The next day I recorded Mary' howl, and that night played the tap out of the cabin window. Big Gra did not answer. Thereafter, he consistently showed that he could distinguish Mary's live howl from recording of her howl. What wa the difference?

I stood by the pen and she teste me. (Instead of howling back, merely noted my conclusions.) Bi Gray proved more consistent than in distinguishing the sounds.

The next winter we replaced wolf as the receiver with a piece o electronic apparatus, a soun spectrograph, which makes a grap of any sound played into it. It portrays not only the main sound known as the fundamental frequency, but also the harmonics Harmonics produce the quality in sound. By differing in number an intensity, they make a note playe on a guitar sound different fro the same note played on a pian (*see above*). The sound spectrograp showed us that one of the way Mary's taped howl differed fro her live howl was by a minor difference in these harmonics. Th tape recording of her howl stressed the second harmonic rather than the first, whereas, in her live howl the first harmonic was stronger than the second.

For a wolf to possess the ability

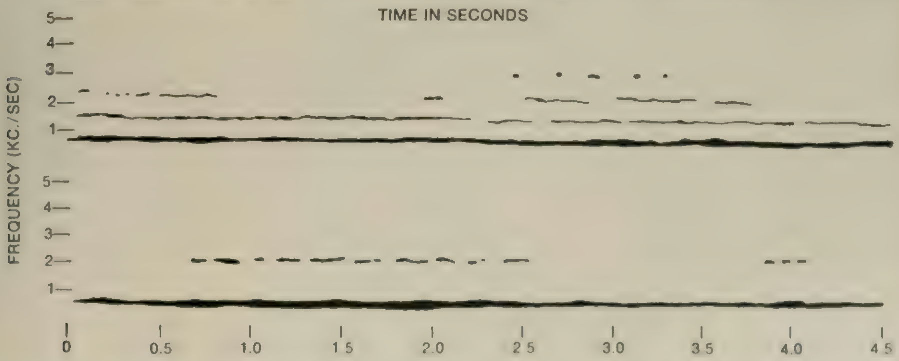


Three captive wolves each howled in different ways at different times, yet each had a distinctive voice quality, shown by these sonograms. Big Gray's howls always contained at least five harmonics; Dagwood's first harmonic was generally strong; Scamp's first harmonic became strong only when the fundamental frequency was between the notes B and F-sharp (that is, between 400 and 500 cycles per second).

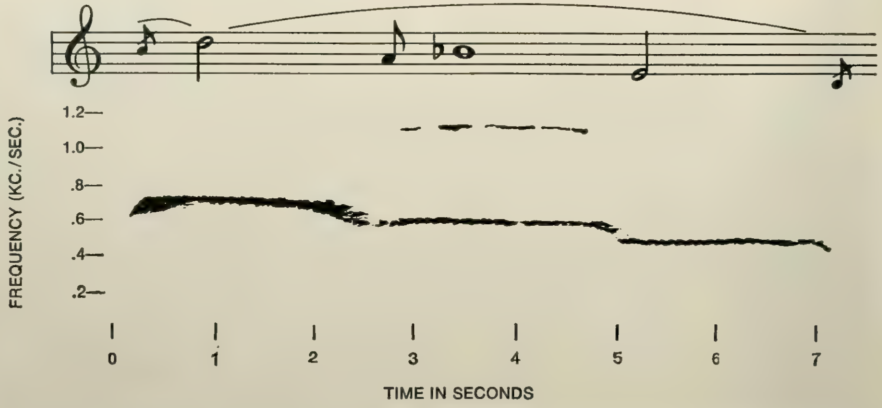
distinguish subtle differences in rmonics argues that the ability s some adaptive significance, that is actually used. It could be used wolf howls had similar differ- ces in harmonics, and if these fferences conveyed some sort of eaning.

My problem, then, became analogous to learning a foreign language without a dictionary or instruction. First, you must recognize units of sound. Then you must determine the pattern in which they occur. Finally, you must recognize the situation in which they are given.

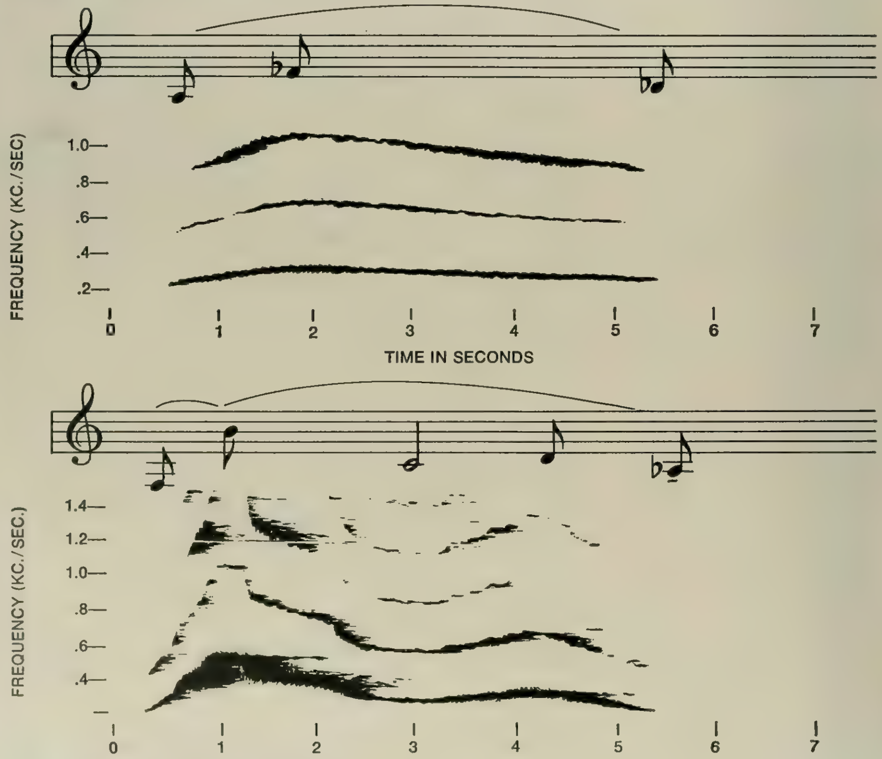
If the English language were analyzed in such a way by someone unfamiliar with it, he would discover certain units of sound: and certain sounds, or words, occurring in patterns; and certain words occurring in particular contexts, as when your hammer drops through a



Big Gray consistently answered Mary Theberge's live howl (upper sonogram) but not a recording of her howl (lower sonogram). The difference lies in the relative intensity of the first two harmonics, a difference almost indistinguishable to the human ear.



A distinctive howl is sometimes given by isolated wolves, whether captive or wild. It drops abruptly in pitch in two places, spanning more than an octave in musical notation. A captive wolf gave this howl one whole night after a pup died.



Big Gray's howls were markedly different if they were spontaneous (upper sonogram) or stimulated by human howling (lower sonogram).

pane of glass you have just replaced.

One night, one of the captive wolf pups seriously injured its foot in the wire of its pen. The pup had to be destroyed. All through that night, over and over again, an adult wolf housed in an adjacent pen gave a very melancholy but beautiful howl. It rose to a high note, D above middle C on the piano, held this for about two seconds, then dropped abruptly four or five notes, followed by a second abrupt drop. In all, it dropped more than a full octave. I had occasionally heard the same howl given by wild wolves, always by single animals far from any other replying voices. Later, when another of the adult wolves was isolated from his pen mates, he often uttered this sorrowful-sounding howl (*page 40*).

Single, sudden drops in pitch occurred in many howls we heard from both captive and wild wolves. I chose these, along with characteristics of the beginning and the end of howls and the pitch of the highest notes, as the units of sound for my analysis.

That first summer, I tape-recorded more than 250 of Big Gray's howls, adding another 400 howls from all three wolves the following year. Where possible, I noted the behavior of the howling wolf—whether it was lying down, standing up, pacing, or running in its pen.

Gradually, as information accumulated, a pattern emerged. After hours of examining sonograms of recorded howls I discovered that in most cases it was possible to distinguish individual wolves by their howls. Despite a great variation in pitch, length, and other features of each wolf's howls, patterns in the harmonics were distinct. Big Gray's howls, for example, always contained at least five harmonics; the other two wolves normally had only two, and never more than four, harmonics. These two wolves, Dagwood and Scamp, differed mainly in their first harmonic. Dagwood's first harmonic was generally stronger than Scamp's. In addition, Scamp showed a unique feature in all his howls: when the pitch of the fundamental frequency was between the notes B and F-sharp, the first harmonic was strong. Most of the midsections of his howls fell within this range. At the beginning and end of his howls, however, this harmonic faded out.

In short, the properties of the howls of individual wolves differ, as do the singing voices of humans. Now we knew that wolves can detect subtle differences in sound, and that they have distinctive howls. The probability that they do actually identify each other by howls appeared greatly strengthened. Just as some birds, such as the white-throated sparrow, recognize and react differently to songs of neighbors and strangers, wolves too may differentiate pack members from intruders by howls. Perhaps this plays a role in passive territorial defense, acting to delineate boundaries with as little strife as possible. Without individual recognition, pack members might well have many more direct encounters with animals in other packs, thus defeating a prime benefit of a territorial system.

When I examined the features of howls in relation to the wolves' behavior, I found that two of the wolves emitted different howls when they were pacing or when they were standing still. When he was pacing,

Dagwood's howls almost never contained a sudden drop in pitch, which they always did when he was still. The exact opposite was true of Scamp. Big Gray's howls did not vary with his movement.

Other differences in the howls of individuals appeared related to whether the howls were stimulated by ourselves or occurred spontaneously. When spontaneous, Big Gray's howls differed in almost every measurable way from howls that were stimulated. Whereas stimulated howls rose gradually in pitch, spontaneous howls began with a sudden upward jump in pitch, often as much as five notes, and ended with an abrupt downward slur; they were normally higher in pitch throughout and shorter in length.

The transfer of information can take place on two levels—universal and individual. Communication that is universal (occurring within the species in general) requires a symbolism that is the same throughout the species. Communication on the individual level may occur among animals that learn to recognize individual traits in animals with whom they associate.

The wolves I studied had grown up with one another. Like two humans of long acquaintance who communicate by means of a familiar gesture, I discovered that in certain situations my three wolves could transfer information—such as the identity of the wolf, and perhaps its emotional state—by variation in the units of sound.

Big Gray hated to be left alone. In August of the first summer we suddenly realized that he had learned to associate our walking past his pen in a particular direction with isolation. We normally left him for a period of hours every four or five days while we returned to civilization for supplies and to backpack in more dog food for him. The trail out went by his pen. We made our discovery one day when, instead of continuing along the trail, we stopped to pick blueberries. Big Gray began to howl. The trail ran along a creek most of the way, and we realized that we rarely had had a chance to hear him howl after we left the cabin. He howled every thirty seconds or so for the next hour. We carefully circled back to the pen and watched him pacing rapidly back and forth between howls.

The next day we repeated the situation and he howled again. From then on we were able to record many howls when he thought we had left him. It was these spontaneous howls that, on later analysis, proved to be different from howls stimulated by Mary.

This discovery, while it may seem obvious, adds an important link to understanding at least one reason why wolves howl, and what kind of information howls may be conveying. If something akin to what humans call loneliness is felt by wolves, and if loneliness causes howling, wolves separated from pack members will howl. It does not matter what we call the emotion. To be coldly scientific we can call it emotion X. But if one manifestation of emotion X is howling, the by-product is communication: information transmitted about the location of the wolf, perhaps its identity, and, if the howl was initiated by emotion, perhaps reflecting this too, as did Big Gray's howls.

Dagwood, Scamp, and Big Gray star in "Language and Music of the Wolves." Associate Members will receive this album without charge as a spring bonus. Additional copies may be ordered by sending $5.95 to:

Wolf Album
Natural History Magazine
85 West 77th Street
New York, New York 10024

In his classic study of wolves in Alaska, Adolph Murie cites many examples of wolves howling when he approached. Group howling, too, is another category. These howls may be motivated in an entirely different manner.

One other facet of wolf howling that has not been explained is its emotional impact on man. The pioneer's fear was expressed by Catherine Parr Trail, who wrote of Ontario in the settlement days of the early 1800's:

"'The wolf! The wolf!' gasped out the terrified girl. Upon the summit of the rock, in the attitude of a sentinel, stood the gaunt-figured animal. A long, wild cry, the sound of which seemed to come midway between the earth and the tops of the tall pines on the lofty ridge above them, struck terror to their hearts . . . . There it stood, with head raised, neck stretched outward, and ears erect, as if to catch the echo that gave back those dismal sounds. They shrank with curdled blood from the cry of the wolf."

That fear has almost vanished, but sadly, so has the wolf from most of its former range. In its last stronghold in northern Canada and Alaska, however, the howl of the wolf still quickens the pulse of man. It epitomizes the wilderness we once fought to conquer and now fight to save. It warns us not to go too far in destroying natural environments. It reminds us that our past was deep rooted in wildness.

The howls are still to be heard, however, even for those unable to immerse themselves in northern wilderness. On an August evening in 1963 some 800 campers, mostly urban people on vacation, met for a "wolf-listening" night in response to posters at the museum in Algonquin Park. They traveled in cars, stopping every mile or so while the naturalist howled. For many this was the first time they had listened to the night forest: a loon on a far-off lake, the deep chorus of bullfrogs. Then, at one stop, they heard a wolf. Suddenly they were no longer standing on a paved road leaning against a modern car. They were no longer mere spectators. For a brief few minutes, they were accepted back into the wilderness.

Park naturalists now conduct regular howling nights in Algonquin Park, and interest is growing fast; more than 3,000 people heard wolves howl on these trips last year.

These people will never stand back and see the wolf legislated out of existence. They will hear that howl and in spirit leave the city and return to the wilderness any time the word *wolf* is mentioned. For whatever the wolf howl means to another wolf, it means more to us.

THE BEAST OF GÉVAUDAN

By C.H.D. Clarke

The horrible deaths of almost 100 people in the French province of Languedoc were once considered indisputable proof of the savage and villainous nature of the wolf

It is possible to foresee, if not to forecast, the day when there will be nothing of the primeval left in this world but a few battered museum pieces. Battered they will have to be if, like our national parks, the public is allowed to tread them. There will be Byron's Ocean, for a while until the aqualungs go deeper. Beasts of raven will have to learn to confine their steps. The wolf howl may go, while the whistle remains. It may be timely, before the howl is gone, to recall the "Beast" of Gévaudan, who certainly did not originate the whistle, but may have been responsible for whistlers being called wolves. In order to do so, the case against the wolf as a slayer of men (and maids) must be reviewed, and this has been done at last by Jacques Delperrie de Bayac in his fully researched and documented book about the most famous wolves in history, *Du sang dans la montagne*. The story is told dispassionately and without sensationalism, by one who obviously likes wolves and wants only the truth.

The truth is grim—possibly one hundred dead people, mostly children—but there is an overwhelming scientific interest, and, in my view, there may be some redeeming features, from the wolf point of view. I obtained, many years ago, a copy of Abbé Fabre's account of the Beast (1901) and was induced to acquire copies of all the writings on European wolves I could. Hence this is really a review of the lot, with many details from Fabre, with the caution that only *Du sang dans la montagne,* recently published by Fayard in Paris, is available and, except for the most curious, is completely adequate. Fabre's details correspond completely except for the date of the first killing, as we shall see.

The wolf, *Canis lupus,* which we call the timber wolf, is a large, doglike, cursorial predator that customarily feeds on large deer or other hoofed mammals. It was originally found throughout the nontropical parts of North America and Asia, all of Europe, and North Africa. It was abundant in the Nile, Euphrates, and Mediterranean cradles of our civilization, and at the time that Columbus sailed it was still common all over Europe. It was exterminated in Britain in the seventeenth century, in Germany in the nineteenth, but still remains in Spain, Portugal, France, Italy, the Balkans, Rumania, Poland, Scandinavia, the Baltic lands, and Russia, not to mention Turkey, Arabia, Persia, India, and various other lands.

In my home province of Ontario, Canada, you can hear its howl within 150 miles of Toronto, while the nearest specimens may be found much closer. You might find one anywhere at all in the northern part of the province, and each year upward of 1,500 are killed without affecting the supply. The species is one, from Labrador westward across forest and plain to the Strait of Gibraltar.

We know a great deal about North American wolves (Young and Goldman 1944). In Algonquin Park (Ontario Department of Lands and Forests n.d.) they run about 65 pounds, with 75 a big one and some females under 50 pounds. European wolves are similar in size. In the western part of the province males average 80 pounds. We are told of wolves in the west weighing 125 pounds, but ours are smaller. Mostly they eat the white-tailed deer. The big ones in the western area can and do kill moose. They also eat grass in spring, raspberries in midsummer, and miscellaneous items—from kitchen garbage and dead fish to beaver at various times. We are often asked if they ever eat men and we can answer truthfully that no man was ever injured by a wolf here. The late Jim Curran of Sault Ste Marie, Ontario, had a standing reward for anyone who had been bitten by a wolf in Ontario, and it was never claimed. His final verdict was, "Any man who says he's been et by a wolf is a liar!" (1940).

So far as Ontario is concerned, that is the whole story, but we cannot dismiss the subject so quickly. We all have been exposed to European folklore. What about the Russian nobleman and his wife in their troika, discarding first the fur coats, then the faithful old family retainer, and finally, either the baron or the lady—depending on the story—to stay the ravenous pack pursuing them? Of course, Baron Munchausen's version is much more interesting—as the wolf caught up with the cutter and sprang, the baron merely ducked. The wolf then lit on the horse and just ate his way into the harness and the baron drove him into St. Petersburg. Much more to the point are the nineteen Russians from Smolensk who had been bitten by one wolf and were sent to Pasteur for his treatment when it was first developed.

What are we to believe? I was assured by Dr. Magnus Degerbøl of the Copenhagen Museum, who visited here in 1938, that the record of the wolf in northern Europe is similar to the one in Canada.

In southern and central Europe things are different. As evidence we have an excellent history of the wolf by Colin Matheson (1944). Here was a peopled earth, not a sparsely inhabited hinterland. The herds of man, as well as the denizens of the forest, paid toll to the flesh-eater, and the lines were drawn between him and the herdsman to whom animals and wealth were one. The despoiler became the arch enemy. Besides, the swineherd drove his charges to the oaks to feed on mast, the shepherd drove his to the mountains, and cattle were grazed in scrubby commons that, in the days before enclosures, merged imperceptibly with the forest. The case was never better put than by the old fell-Lapp, Turi, who was induced to put in writing the lore of his people (1931). Says Turi of the Lapp herder who has caught a wolf, "and when he has half-killed him, then he begins to curse and swear and say, 'You have eaten my draft-reindeer and my reindeer cows, now eat some more, cursed breed! . . .' But the wolf hunter who often kills wolves, he does not shout at the wolf, nor swear at it either, he knows that the wolf only does what it must, and that he may not kill more than he is allowed to, just as there is a limit to the waves of the sea, how high they are allowed to raise themselves!"

There, where herding and hunting meet, one man could write with understanding of both, but left no doubt as to where he thought the truth lay. Primitive hunters, who have seen wolves in all sorts of activities, from play to hunting, from the gentle solicitude of the bitch with pups to the unflinching snarl with which death is met, hold them in high esteem and often claim clan-kinship with them. Occasionally a trapped wolf wags its tail and whimpers when man approaches, and that, says Turi, is the worst.

It may be belaboring the point, but there is even a tendency on the part of man to take depredations on his flocks more seriously than those on other people's children. We have been given a graphic account (Patterson 1912) of the man-eating lions that held up railway construction in Kenya, and note that the Indian workmen were little impressed by Colonel Patterson's efforts to kill the beasts, which removed one of their number almost every night, until at last one of the sahib's goats was taken. Now, thought they, the lions will catch it! They have gone too far! As in so many of our beautiful non sequiturs, the subsequent event seemed to justify the thought.

Not the least impressive thing about the fell-Lapp's attitude, like that of all primitive hunters, is that he was not afraid of the wolf. This fits in with the report that, in spite of legend, the wolf in the northland did not molest men.

Against that we can set the traditional "wolf bogey" of southern Europe. Matheson's record and Delperrie de Bayac's detailed study show that it was, on the face of things, warranted. The last person shown to have been killed by wolves in France was a woman in Haute-Vienne, in 1918. Wolves have been scarce more recently. Before, there was a girl at Cara in 1914. Before that there were others and still others, in France, Spain, Germany, Poland, and Russia. In 1875, 161 persons were killed by wolves in Russia. In 1814 there were 19 in the Posen area, and so on and on, to a total that unquestionably, in the course of centuries, ran into thousands, including, we are told, one king of France, Louis d'Outremer, the son of Charles the Simple.

What is it all about? And why the difference between northern Europe and southern Europe? Fortunately, we are able to draw conclusions based on many pieces of evidence, and we soon arrive at a simple explanation, which is that reached by Delperrie de Bayac, although he does not stress it. The wolves of southern Europe were no bigger or more formidable than others—if anything, they were on the small side—no more fierce, or bold, or less fearful of man. The only difference was that they were frequently rabid. The generalization "wolves don't bite" has to be modified to "wolves don't bite unless they have rabies." This is borne out by the assertion of Slubczakowski (1968) who wrote out of long experience in Rumania, where more than 5,000 wolves were taken in a year in the mid-fifties, after a wartime build-up in their numbers. He says flatly that only rabid wolves attack people.

The best clue to this is in the numerous descriptions of actual attacks in Matheson and Delperrie de Bayac. One wolf in Puy-de-Dome bit twenty-eight, of whom twelve died. One in Indre in 1878 bit seven, of whom three died. Delperrie de Bayac records seventy in Auvergne in a month.

Of Pasteur's nineteen Russians bitten by one wolf, his rabies treatment saved sixteen; the others had been so badly torn that they died anyway. As we approach the centennial of Pasteur's work, we are apt to forget that previous generations commented little on attacks by wolves because they fully understood them. Down the long list of recorded attacks by wolves it becomes clear that the Russian baron in his troika is folklore, but the rabid wolf was grim fact. The pattern is universal. The famous wolves of medieval song and story were all rabid. A reading of the "lays" or epic poetry describing them is enough for anyone to see for himself—the Beast of Carmarthen, the Beast of Orléans, the Beast of Ardennes, and so on. In fact, they may even represent rabies outbreaks, recorded as demoniacal possession of single animals. In retrospect, it was a good thing that Llewellyn slew Gêlert. If he had not, he might have had a rabid dog to deal with.

The attitude of the people shows that they understood perfectly the connection between rabies and attacks by wolves. They were not afraid of wolves. Not too long ago the barefoot shepherdess was a real and familiar figure. Cattle, sheep, and goats were sent into wolf-infested forests day after day, herded by village children of all ages and sizes. When wolves attacked their charges they were driven off by dogs, or if there were none, as was often the case, by the children themselves armed with sticks and stones. Here was the contempt bred by familiarity. Were not the herders aware that the boldness of the wolf might be due to rabies? The answer to that was that by tradition and experience they were trained to recognize that particular type of boldness, because the danger from their own dogs was greater than that from wolves. Rabies was common and unchecked, its infectious nature known, but its prevention unknown.

One of the best evidences is to be found in the old bounty lists of France, as given by Gérin-Ricard (1900) in a bounty list that gave a higher premium for "wolves rabid or having attacked man." The two things were synonymous.

It should be added that there exists in Europe a tradition of wolves eating the flesh of people who were helpless or already dead. The Greek wrestler Milo of Croton, a copy of whose commemorative statue still exists and who was a six-time winner at Olympia, died so in the forest near Croton. Seeing a cleft tree, he tried to push the two halves apart by main strength and was caught in a vise of his own making. When he was found the wolves had devoured him. In years of famine and pestilence, war and desolation, tradition has it that wolves attacked the dying as well as the dead. It may have been so, but it was also almost a cliché of the chroniclers to end their chapters of horrors (mostly caused by their fellowmen) by saying that corpses lay unburied from All Saints' to Easter and that beasts of the forest howled nightly and held the countryside in terror of their attacks. The attitude of the people to wolves in more normal times did not change. We can discount the romancing. One of the last to capitalize on it was Toronto's Ernest Thompson Seton, who, while an art student in France, painted a picture called *Awaited in Vain*, showing a French peasant pulled down and eaten by wolves in sight of his own cottage. It was received with scorn in most quarters, and his fellow-Canadian Dr. William Brodie drew attention to the neatness with which the wolves had piled the defunct's clothing.

In southern Europe rabid wolves attacked man and he succumbed to their bites. In northern Europe and North America there is no such history. We should be able to say that rabies on this continent was brought in by civilization. However, there has been a history of fox-dog-wolf epizootics in the Arctic going back as far as records go. Their etiology was not known and the whole story is still far from known, but there are several interesting facts. One is that affected animals sometimes lose fear of men and dogs, and bite many people. The second is that there is no tradition that these bites are dangerous and might cause death and no identifiable history of deaths from rabies. The third fact is that the Negri bodies of rabies have recently been found in sick foxes, dogs, and wolves from the Arctic. We can, however, say that while these facts do not justify taking chances with any rabies, there is no parallel in North America to the European death toll from rabid wolves. Rabid foxes and skunks have caused deaths, including a governor of Lower Canada, but not wolves.

Another thing about rabid wolves is that they attack the face and neck, just as wolves ordinarily attack their prey. Many victims die directly from the wounds.

You will notice that the great wolves of history were known as Beasts (Matheson 1944, Coudray-Maunier 1859, Lecocq 1869, Buffet 1587). We are sooner or later led to the one Beast that confounds all our theories and possibly also destroys all our complacency. The Beast of Gévaudan does not fit into the pattern. The fact was known at the time and yet, like many other pieces of authentic history the truth sometimes gets lost in the crust of accumulated fiction—so much so that some years ago *Life* magazine, in describing a hunt for some escaped zoo animals in the Alps, said that "unlike the legendary Beast of Gévaudan of centuries ago," they were real. The Beast was no legend.

What actually happened is that from July, 1764, to June, 1767, wolves terrorized the regions of Gévaudan and Vivarais in France around the mountain massif of the Margeride, killing and, for the most part, eating many persons, before being finally hunted down at a cost of 29,000 livres (pounds) to the state and nearly four years of serious disruption to the life of a province. Communications were poor and romancing on this subject was so widespread that contemporary authorities like Buffon justly criticized the press accounts, although he himself did not have all the facts. It remained for the Reverend Abbé Pourcher to publish a history in 1889, followed by Abbé Fabre's account based on parish records, so that the Beast stood as well documented as the Frisco fire. To cap it all, we now have a definitive history.

Delperrie de Bayac searched remaining parish records and archives and traveled over the whole area involved. The one discrepancy with Fabre shows conclusively that the first victim of the Beast—a fourteen-year old girl, Jeanne Boulet, of the hamlet of Ubas (Habats in Fabre), parish of Saint Etienne-de Lugdarès in Vivarais—was killed on June 30, 1764, and not on July 8 as stated by Fabre.

I have never seen Pourcher's account, but it is obvious from Delperrie de Bayac and others (e.g., Benech 1969) that he was very religious and tended to romanticize, and apparently the romantic details came from another religious, his aunt, "soeur du tiers-ordre," who had them from her father, Pourcher's grandfather, who in turn attributed them to Jean Chastel, a relative and one of the principals in the story. According to Delperrie de Bayac, Pourcher is responsible for the theory that the Beast was a supernatural creature sent to punish people for their sins.

Most English-speaking persons got their impressions from Robert Louis Stevenson's *Travels with a Donkey in the Cévennes*. He traveled through the heart of the wolf country and his story of the Beast was evidently influenced by a novel, *La bête du Gévaudan*, by Elie Berthet, which along with a more recent novel of the same title (Morreau-Bellecroix 1945) has also given most Frenchmen their ideas. Of the first, the chronicler Fabre remarks, "Les traits principaux n'ont rien de commun avec l'exactitude historique des faits." I have never seen it, but the more recent novelist has evidently read Pourcher and used his material as a backdrop for a love story and whodunit combined.

Before getting into our story it may be well to look at the country. Delperrie de Bayac has photographs of important scenes as they are today. It is a rocky height of land, mostly in the Department of Lozère. To the north are the rich midlands of France, to the south the sunnier and drier, though no less rugged, area of Gard. The mountains are not high, but wildness was provided by a network of ravines and gullies, then much covered with scrub, which in the recent war we learned to call *maquis*. Letters preserved from the wolf hunts indicate a land already prey to disastrous erosion, because they mention that the streams in the ravines could become torrents in a short time. In particular, they speak of treacherous mudholes often covered by a deceptive surface of green vegetation. In these *moulières*, called *las mouleyras* in the local dialect, men and horses could become mired and in danger of their lives, but wolves crossed them easily and never failed to take advantage of them.

The whole area is in the ancient province of Languedoc. While the people of Gard stand out in Stevenson's description as the Mediterranean type of Frenchmen, those of Gévaudan are clearly the dour alpine type. There may still be wolves there. According to Menatory (1968), one was killed in January, 1951, in the canton of Grandrieu in Lozère and Delperrie de Bayac has the details. During the recent occupation the Germans had trouble with parts of this countryside. Before the Edict of Toleration one of the last prosecutions of a Huguenot pastor occurred in the wolf country, but at the time of the wolves the religious troubles must have been a dim memory, and the populace was clearly devoutly Catholic. Nearly a century later, in Robert Louis Stevenson's time, the Beast episode was on the way to being forgotten, a process Delperrie de Bayac shows to be incomplete even today, 100 years later. The description Stevenson gives of how he lost his way in the miles of scrub, with its confusing cow paths, inhabited by bands of mocking children driving their animals home after dark, surely gives us a good setting for the documented history of the wolves. It is obvious from Delperrie de Bayac that there have been vast environmental and social changes since Stevenson's time, for the worse so far as wildlife is concerned.

Startling news was spread around the Margeride in July, 1764, as we have already noted. Before the shock had worn off, on August 8, another girl, fifteen years old, was killed at Masmejean, in the parish of Puy-Laurent in Gévaudan. People began to be frightened when, late in August, a boy of fifteen was killed in the same manner at Chayla-l'Evêque, parish of Chaudeyrac (where Stevenson had some of his adventures). What was up? Nobody knew! It became known that the killer was either a wolf or wolflike. Shortly after, another boy was killed in the same parish. Then on September 6, a woman of thirty-six was killed at Estrets, parish of Arzenc, and on the 16th at 6:00 P.M. a boy at Choisinets, in the parish of Saint-Flour.

Genuine alarm was felt and a complaint was made to the syndic of the bishopric of Mende. Simultaneously there was a seventh victim, a twelve-year-old girl. M. Duhamel, captain-aidemajor of the volunteers of Clermont, a captain of the Régiment de Soubise according to Pourcher (Benech 1969), was sent by the governor of Languedoc. He billeted forty dragoons in Langogne and organized hunts.

That the captain was an experienced wolf hunter s apparent from the fact that he started to get wolves—the first, a big one, killed on September 21 in the parish of Luc. The dreadful toll coninued, however: a twenty-year-old girl at Apchier, also spelled Apcher, on October 7, followed by an attack at Pouget, in the parish of La Fage, on a fifteen-year-old youth, part of whose head was orn, then two more girls devoured at Contrandès and Grazeires.

By now the story had spread to Paris, and its embellishment had begun. Also, M. Duhamel had to move his troop to an inn at Saint-Chely. While his dragoons were charging back and forth there came an account of a woman attacked and bitten on the lip only. Notice now that we have two persons bitten on the head and face. Everybody in those days knew that in such bites from rabid animals death came much more surely and quickly than from bites elsewhere on the body. t became apparent that these were not rabid wolves. The devouring of victims had indicated this all along, although a rabid wolf may, at times, eat part of a person who has been killed directly by ts bites. The certainty that no rabies was involved meant that there was something going on that was without precedent.

M. Duhamel did his best to follow up every attack, but without success. As the toll of death and injury mounted, official concern increased. Finally, by order of the Bishop of Mende, the Blessed Sacrament was exposed in all the churches of the diocese on January 6, 1765, and special prayers for relief were offered. On the very day of prayer two people were killed in widely separated places. This in itself was interesting because it gave the first good evidence of what later became known, that the Beast was really more than one animal. But by that time the term Beast was too firmly established ever to be uprooted.

Six days later the most famous incident of the whole terror occurred. Seven children of Vileret d'Apcher, five boys and two girls, guarding their herds together, were attacked. Groups of this size were formed, so we are told, solely for protection against the Beast. The three oldest boys, twelve-year-olds armed with homemade pikes, stood their ground, led by a boy named Portefaix. The wolf broke through their guard and seized the smallest boy by the cheek. The three big boys made him let go at once, but he renewed the attack and knocked down the other small boy. Driven off again, he came back once more, seized the little fellow by the arm, and dragged him away. All the other children attacked him, but he would not let go and was getting away with his victim until Portefaix and a boy named Couston forced him into a mudhole where they all rained blows on his head, compelling him to let go. He attacked his attackers and left his tooth marks in Portefaix's homemade pike, but they confronted him so resolutely that he took flight.

When the news of the incident was confirmed, the boys received both praise and rewards. Portefaix was removed from his humble home to be brought up as a gentleman at the expense of the state. He died a lieutenant of artillery at Douai, in 1785, an early death, in peacetime, possibly brought on by service in India. Grimm, the friend of Rousseau, wrote a poem about him and his adventure.

Here again, we must notice how frequently comments were made on the fact that victims were bitten in the face and recovered.

Fabre records eight deaths in January, three in February, five in March, seven in April, five in May, one in June, two in July, and two in September. A number were attacked and escaped. They were mostly adults. Only one adult man was ever killed—in April, 1765. He was probably too terrified to fight. Active and vigorous men never failed to face the wolves down. There were not many grown women among the dead, but they figure prominently among those who were bitten and escaped with their lives.

Duhamel and his troop tried every device they could think of. They got wolves, but not *the* wolves. They beat the woods and sat up over bodies. A special bounty of 6,000 livres was set by the crown, 2,000 by the States General of Languedoc, 1,000 by the Bishop of Mende, and 200 by the syndics of Gevaudan and Vivarais—9,200 livres reward in all, an incredible fortune in purchasing power where 200 was riches. Lucky the man who owned a gun!

The governor then commanded the populace to assist in the drives. People were reminded that whereas the law forbade killing game, the wolf was excepted as noxious.

A contemporary exhortation was couched in these words:

> Courage, chasseurs de France,
> Partez, pour le Gévaudan.
> Allez-y en diligence,
> Ne perdez pas un moment,
> Poursuivre cette Bête
> Qui ravage ce pays.
> Et votre fortune est faite,
> Si vous remportez le prix.

On January 14 a young woman escaped after a heroic struggle in which she was knocked down several times and severely bitten.

On February 7 a hunt was staged by men of seventy-three parishes, 20,000 in all. Everyone thought it would work; even in Paris news was anxiously awaited. There was snow and they had track of the Beast. At 1:00 P.M. it was shot and wounded, but it got away. A follow-up of seventeen parishes failed; so did a general hunt after a fresh kill of a fourteen-year-old girl. Noblemen of France also came to hunt, including a LaFayette, but depredations went on.

Meanwhile, Beast or no Beast, Captain Duhamel was unpopular. In the religious troubles the principal form of pressure on Huguenots had been to quarter dragoons on them and then close the official eye to all indignities. Even a short period of quartering can reduce a band of heroes to ruffians in the eyes of the host community. Wrote the Sieur de la Barthe to the intendant of Languedoc, "The dragoons treat Gévaudan like a conquered country." Especially he damned their horses, which, he said, were destroying the harvest, and were as necessary to wolf hunting as a third wheel on a chariot. All this got as far as Paris, and all that was needed to bring the whole thing to a head was the failure of the two great drives. The dragoons were called off. As a last resort they had tried to fool the wolves by dressing sheep in shepherdesses' clothing—and had fooled nobody.

Far away (as news went then) in England, which had recently conquered the French colonial empire and concluded a triumphant peace, it was reported that a wolf had routed the French army.

As a replacement for the dragoons, the king sent a Norman squire, M. Denneval, and his son with a pack of trained dogs. They arrived before the dragoons left, and even while they awaited their dogs, they complained of the daily drives that were successful only in disturbing the quarry, which still continued "its" toll.

In France the "wolfer" (*louvetier*) was a royal officer. The Grand Louvetier was an officer of the royal household and the title was held by a series of distinguished gentlemen, from Gilles le Rougeau, the first, in 1308, to Napoleon's Marshal Berthier, prince of Neufchatel and Wagram, grand dignitary of the Legion of Honour, vice constable, grand hunter (*veneur*), and grand wolfer of France, who held it from 1804 to 1814. Since then the office has merged with that of Grand Veneur, as a royal or imperial dignitary when there was such, or the Directeur-Général des Forêts under various republics (Gérin-Ricard 1900). When the Beast was at large the Grand Louvetier was the Chevalier de Flamarens. Each such official in the various provinces had under him, as the occasion arose, lieutenants de louveterie, who in turn had sergeants, whose job, as nearly as one can see it, was to take the initiative in wolf hunting and maintain wolf-hunting dogs. The office carried with it revenues and prerogatives and, in addition, special premiums were paid on each wolf destroyed. In 1764 this system should have been in full bloom, and it is a wonder that nobody thought of these official wolf-slayers before.

M. Denneval, having come all the way from Normandy, must have been reckoned one of the best of the lieutenants. He was likewise sincerely moved by the killings of women and children, which continued at the rate of four or five a month. During the course of his hunts the Beast was identified and seen to have a mate.

M. Denneval tried poisoning bodies, without getting the Beast. He also kept the men of the countryside busy in a continual series of hunts, so that normal life was impossible and the farms and villages buzzed with criticism. The disruption caused by the wolves was, in fact, threefold. Hunt-g occupied time that should have gone to farm-g, and the crops of the conscript hunters suffered. he children and their herds had to be grouped to ve safety in numbers, making for cumbersome nd inefficient grazing. There was an almost com-ete cessation of travel at night. All this was, of urse, in addition to the loss of life.

On May 1 one of the Beasts got a bullet. Also May, in another incident of heroic self-defense children, four boys, aged ten to fourteen years, ere attacked while herding cattle, but the wolf as routed with clubs and a homemade pike ielded by the oldest. One little fellow clouted him the nose and made him cough! There were ore incidents that indicated at least two Beasts, though they were not so interpreted until later. ore hits were scored by the hunters. On May 18 e wolf was severely wounded, yet on the 19th a aiden lady of fifty was killed, and that particular east, in true wolf fashion, returned later to its ll. On May 24 one wolf got a deep bayonet wound the flank.

The Dennevals had been hard at it since Easter. ny one of the encounters reported above could, ith a little luck, have been kills, but unpopular easures and failure do not go together, and in ne, M. Denneval and his son were recalled.

This time the king sent an officer of the royal uard and member of his household, M. Antoine e Beauterne, porte-arquebuse du roi, together ith his son and an outfit similar to that of the eparted Dennevals, but much better. The new an promptly proceeded to organize the identical egimen of drives and hunts, but his was the luck. o ruthless were his proscriptions and conscrip-ions that sowing and harvest alike were neglected nd the peasants were in want, but he was able to epart a hero. The real substance of his attack was ourteen of the best gamekeepers and four (two eashes) of the best trailing dogs in France.

One of his hunts was related to an incident which may have provided the stimulus for the 'beautiful shepherdess" stories repeated by Rob-ert Louis Stevenson and presumably featured by he Berthet novel, although Delperrie de Bayac, as pposed to Fabre, does not feature it. A girl of the illage of La Vachellerie, parish of Paulhac, dis-appeared suddenly at about seven or eight o'clock on the evening of September 8. A shepherd found her coif, and M. Antoine was sent for, being reached at one in the morning. He arrived in three hours with four gamekeepers, *limiers,* or leashed trailing dogs, and a number of hangers-on. The *valets de limiers* ("dog handlers") and gamekeepers took the trail and after finding successive items of torn and bloodstained clothing, came on the naked body, the throat pierced by fangs, which had caused the great effusion of blood, and one thigh eaten to the bone. Our modern whistling wolves were presumably so named because of a propensity to denude and devour.

By this time we are able to see that the greatest loss of life had been in the wildest part of North Gévaudan on the slopes of Montmouchet, a high peak of the Margerides.

An armed muleteer missed his shot at the Beast on September 11, was borne to the ground and rescued by his comrades. On September 13 the third victim of the hamlet of Pépinet was taken, a twelve-year-old shepherdess, whose homemade bayonet failed to protect her and was found stuck in the ground by her shoes when her frantic parents went out in the dark to look for her. We are given a harrowing recital of her funeral.

The Sieur de Beauterne, or M. Antoine as he was called, seems to have been a fairly notable man, a hereditary porte-arquebuse according to de Janti (1965). We are told that he had hunted for fifty years in France, Germany, and Piedmont. He must have been close to seventy years old, yet he was vigorous and active, and full of sympathy for the distressed people. A hunt organized by such a distinguished court officer, one with such a vast sporting experience, would have attracted any sportsman of rank and means who could attend. This hunt was the most remarkable of his career, and distinguished officers and noblemen came to help, some with their own kennels of hounds. His gamekeepers and the two *valets de limiers* knew their business. They recognized the track of the great wolf and never brought in the hunt without good reason. In spite of that he had had three months of frustration. From his letters we learn details of past troubles. Two gamekeepers taking part in a promising chase stumbled into a *moulière.* Others, including Denneval, had come to grief in these invisible traps, as M. Antoine called them.

[illegible]

Only on Sundays

Female liberation may have touched Athens, but in traditional Greek villages women continue narrow, housework-oriented lives

by Muriel Schein

The 430 inhabitants of Kriovrisi, a remote village high in the Pindus Mountains of northwestern Greece, belong to an ethnic minority known as Koutsovlachs. They are Greek in religion and other major cultural characteristics, not the least of which is the position of women.

Residing in stone houses clustered on a steep mountain slope, the people of Kriovrisi eke out a living from small, barely arable plots in the shallow valley below the village and from overgrazed pastures and pine forests on the surrounding mountainsides. The majority of the men are shepherds, keeping flocks of sheep and goats; the rest farm or engage in miscellaneous occupations. Their work requires a multiplicity of skills, entrepreneurship, travel, and contacts. In contrast, the lives of the women are similar: all perform the basic tasks of cooking, cleaning, clothes making, and child rearing.

The contrast between the diversity of men's labors and the similarity of the women's was brought home to me when my husband and I spent a year studying the lives of the people of Kriovrisi. Despite my urban American background and my specialized training for ethnographic research, I could immediately empathize with the women and discuss problems of household management with them; whereas my husband found that the men's routine activities were not at all like any work he knew, and he had to learn about them from scratch. In both cultures, all females are taught household skills early in their lives; males, however, may have one of a variety of jobs, choosing a specific occupation and learning the requisite skills much later.

Like many others, I have long been interested in this widespread contrast between the lives of men and women. My own concern with women's liberation led me to observe the lives of women in Kriovrisi and to compare them with our own. In my opinion, the conditions underlying women's lives in villages like Kriovrisi and in cities like New York lead ultimately to feelings of discontent among women. Yet I know that Kriovrisi women are content with their lives, and I recognize the validity and appropriateness of their feelings. Current thought tempts one to say that the position of Kriovrisi women results from male oppression. However, although male chauvinism indeed exists in the daily life of Kriovrisi (and of New York City), it is nowhere the cause of female oppression. Seen from afar, the activities and prestige of each sex form parts of a total system. Here, then, we can examine the lives of women in one small village and perhaps understand one part of this system.

In Kriovrisi, a man's achievements—the type of work he does, the degree of financial success, his largesse toward other men—partly determine his own and his wife's social rank. Nonmanual labor is more prestigious than manual labor. The wife of a shepherd or a farmer will at times have to work in the fields or the pastures. Based on this criterion the wives of the village stock merchant, of the village cheese merchant, and of the village secretary rank highest. Most occupations, however, involve manual labor, so that the rest of the villagers are then judged according to their earnings. The merchants are the wealthiest, and shepherds tend to be wealthier than any others.

A further consideration is independence. It is preferable to work for oneself, but a wealthy hired

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In her modern Sunday-b
a newly engaged woman sta
in front of the whitewash
wall of her village ho

Even as they dance to the casual tunes of gypsy musicians at a festival, two young girls are already preparing for motherhood by caring for a younger brother.

herder will receive more prestige than a poor independent shepherd. The uses to which a man puts his income also affect his rank and, therefore, that of his wife. These uses include meat once a week, wine and liquor for guests, urban-style clothing, a house in good repair, and a secondary school education for his

The *babou*, or "old lady," often dressed in black, rules the lives of daughters and daughters-in-law, left, and cares for her grandchildren, below.

ns. In addition, he must be gener-us outside his household, treat other en to coffee or drinks in a cafe, ıd publicly pay large sums to the ands of musicians who come to riovrisi on festival days.

The behavior and demeanor of er children, their progress in hool, and their prospects for marage and work also contribute to a oman's position. It is a great disppointment if a woman is childss. but it is considered foolish and nimallike to have more than four nildren. When children are below chool age, they are their mothers' pecial responsibility. Our landdy, Evanthia, told of a time durıg the Greek civil war (1947-49) hen she was alone in her home ith her young son when the enemy rrived. She feared for her son's fe not only because she loved him ut also because if anything had appened to him, "my husband vould have killed me."

If children attend school reguarly, learn to read, write, and ount, and win prizes on the annual ay of promotion in June, both hey and their parents receive raise. Passing the examination to ttend secondary school located in he county seat brings even more onor to parents, especially to nothers. As they mature, children nust behave respectfully toward heir elders. A well-behaved child, n entering a room or store where eople are sitting, always says, 'Good-day to you," and "goodye" on leaving; to omit this will ring forth comments on the child's pbringing. Thus, the low opinion hat the village women had of one woman, who was poor and who, with her husband, had once held unpopular political views, was ameliorated somewhat by the educational achievements and good manners of her three sons.

The marriages parents arrange for their children can also bring prestige. If a mother has raised her daughter to be a skilled housekeeper and if a father has amassed a dowry of $2,000 or more, they can find a suitable husband for her, say, a clerk in a town bank. Such a marriage means upward mobility for the daughter and is a tribute to her parents' farsightedness.

A woman's household skills, the final criterion of prestige, also bear on the other criteria, for her children's behavior and her husband's business success depend to some extent on how well she feeds and clothes them. Her house must always be presentable; indeed, cleaning and decoration are frequently done with the thought that "someone might drop in." This standard requires daily airing of rugs and blankets, sweeping, polishing of the glass shades from the kerosine lamps (Kriovrisi has no electricity), and two or three trips to one of the 13 village springs for water. Women take pride in this hard work.

Daily household work includes food preparation. The housewife provides coffee and bread for breakfast, the main meal at noon or one o'clock, and a supper of leftovers and salad at seven or eight o'clock. Because the midday meal is the most important, providing the most nourishment, it requires planning and creativity. As one woman put it after we had finished the midday meal, "Well, that's another day taken care of." A good housewife can feed unexpected guests, and can offer sweets, coffee, and liqueurs to afternoon and Sunday visitors.

In addition to the daily routine, there are other occasional but essential tasks. Women bake all the bread, which constitutes half the diet, a dozen or so loaves at a time. They are very critical of their own and others' bread, often comparing lightness, texture, and taste. Periodically, clothes, blankets, and rugs must be washed and clothing ironed. The industrious housewife collects brushwood to burn in the oven and chops the firewood that her husband or son has brought from the forest. The most fastidious and admired housewives clean their houses thoroughly once a year, usually in June. This can take two or three weeks and involves not only scrubbing and repairing furnishings but also covering the walls with lime, which makes them white and bright and "kills germs."

When all of these maintenance tasks are done, women devote their time to other, more creative work in which they take a great deal of interest, and which provides a more durable basis for prestige. In May or June they begin to wash and dye wool gathered from their own sheep or purchased from shepherds. They spend all their free time spinning. Once the wool is spun, the women knit underwear, socks, and sweaters, or weave blankets and rugs. The older women sometimes make original patterns while the younger women copy designs of rugs that they see in urban magazines. They discuss and compare each other's rugs, most of which are for household use. Only a few of these are sold at the annual bazaar held in the county seat. Married women work on items for their own houses, while unmarried women make their trousseaux.

In part, then, women derive their identity from their work. Men do certain things, women do others. Women take pride in their ability to do necessary work that men and children cannot do for themselves. When Evanthia's sons were leaving on their winter migration with their flocks, her daughter, Amalia, packed their clothes and set aside food. I suggested that the men could do that themselves. Amalia said, "They're men and they don't know how," then added that men are not inclined to do this work and do not want to learn, for it would be inappropriate for them.

A woman gains her identity and prestige primarily from family and household activities. A woman's personal creations, represented, for example, by woven woolen articles, can be worked on only when the major and most time-consuming treadmill tasks of household maintenance are done. Her only other products are her children. It is not surprising, then, that a woman's prestige derives, not from her own achievements, but from those of other members of her household and family line. Even the name that many people know her by is not her own, but her husband's. She takes not only his last name but also his first; if his name is Takis, she is known to his relatives and friends as (Mrs.) Takina.

In contrast, men engage in various business pursuits, and have personal transactions with men from other households, as well as with merchants and government officials outside of Kriovrisi. Their prestige and rank are not limited to household and family, although these are important.

In Kriovrisi, this situation exists because there is no alternative role for women. Not only would few men and women seriously consider other activities as appropriate for women, but the village's economic and social structure does not permit other possibilities. Females are brought up solely to perform the combined role of wife and mother. When a girl is born, the joy at her birth is tinged with disappointment. Although all children are valued, sons affirm their fathers' masculinity. Furthermore, daughters are an economic burden. Sons bring in money in the form of a wife's dowry, daughters take it away for their dowries.

Young girls are encouraged to perform womanly tasks. By the time they are six, they learn to spin, using a stick and a bit of old wool their mothers have given them. Two or three will stand on a pathway, in perfect imitation of their mothers, spinning and talking. Both boys and girls begin school at age six, but six grades are considered sufficient for girls. They will, after all, marry; secondary education is not necessary for that. In Kriovrisi only 4 girls out of 62 unmarried girls of the appropriate age were attending secondary school or a university in 1967-68. It is a different matter for boys, who are encouraged to go on to the six-year high school if they can. Since not all boys can make a decent living in the village, an education is important for it may lead to economic and social mobility outside the village. Although schooling is free, the student must pay for room and board in the town. While some return on this investment can be expected for males, this expense would be a waste for females who need the money for dowries. In addition, the income an educated boy can earn helps to dower his sister.

So girls finish school at age 12. Having learned to sweep, fetch water, and care for young children, they now begin to weave and knit. They practice by knitting heavy sweaters or weaving saddle blankets and pack bags from coarse wool. After a year or so, they start to use finer wool to weave the rugs, blankets, and pillow covers that will form part of their trousseaux. At 13 or 14, they begin to take over the heavier household tasks, while their mothers do the cooking.

During these years, girls spend most of their time with other girls, a pattern that they will continue for the rest of their lives. In Kriovrisi, the separation of space into male and female worlds is not as sharp as in some Greek villages, where women are forbidden to enter cafes, but it exists. Males, when not working, relax in cafes or near the village office with other males. A female spends any free moment she has with other females in or near the house. This leisure is always busy leisure. On most occasions, a woman's hands are occupied with some useful work. As Evanthia said, "If I sit with my hands empty, I feel I've done nothing; but if I spin, at least I've eked out a few cents." Friends will spin or weave together, they may help each other work, or they may bake a cake together. It is only on Sundays that their hands are free from labor for an hour or two; then after church, they will walk around the village together, dressed in their finest.

Public contacts between young men and women are limited. Again, on Sundays, they may meet, perhaps during their stroll. On festival occasions, when a gypsy band visits the village, boys and girls do traditional dances together.

At this time, the parents are arranging the girls' marriages. Only recently have a few girls begun to choose their mates. Parents look first among the best families of Kriovrisi, thus insuring that their daughters will remain nearby, and that the bride and her in-laws will not be strangers to each other. More and more often, however, because of the population decline in Kriovrisi, they must ask friends and relatives outside the village to find mates. When a suitable mate is found, both sets of parents negotiate the dowry, and the marriage ceremony takes place soon afterward.

After marriage, the male-female separation may continue, depending on the type of household that the bride and groom establish. There are two major kinds of households: the nuclear family, composed of a married couple and their children; and the stem family, composed of a married couple, their son, and his wife and children. Most households begin as stem families, becoming nuclear if the two couples quarrel and separate or if the elders die. In such households the division of labor between males and females tends to have more daily importance than the conjugal ties.

In 1968, Ioannis, a young shepherd from Kriovrisi, married Sophia, a girl from another village. She moved into his household, comprised of his parents and his four sisters. After the wedding, Sophia and Ioannis rarely appeared together. He was either in the pastures with the sheep or in a cafe with other young men. She was always in the company of at least one sister-in-law or other female relative.

The bride begins a second phase of her education when she marries. Sophia's mother-in-law, Anna, and sisters-in-law were, for example, teaching Sophia how to spin, a skill that for some reason she had never acquired. At first Sophia did the heavy work and only such minor cooking tasks as making salad, while Anna did most of the cooking. The bride gradually learns the finer aspects of cooking. This is considered wise and proper, for there is an old story about a woman who wanted her daughter-in-law to do all the cooking. The daughter-in-law did, but because she came from a wealthier household, she used

The unmarried wom
set housework aside and m
the young men of Kriovr
only on Sundays. Togetl
they perform a traditio
Greek dance in a churchya

nly butter and no oil in her cookng. Soon the woman discovered hat there was no butter left, and rom then on she did all her own ooking.

In her new household, the bride s subject to the authority of her usband and of her in-laws, both male and female. Among the women, a division of labor and a hierarchy of authority develops. In this particular household, Anna was n charge; of her four daughters, the eldest (20 years old) was second in command and directed the other three, as well as Sophia, in their tasks.

The relationship between mother-n-law and daughter-in-law tends to be fraught with tensions, as attested to by the many jokes that women tell. It seems that daughters-in-law are expected to be lazy. Once when I was standing with my arms folded, our landlady, Evanthia, said to me, "Why are you standing with your arms like that? Do you think you're a new daughter-in-law?" The bride must learn to perform household tasks in a way that pleases her mother-in-law. If she is strong-willed, then fights are likely to ensue.

The newly married woman may also have to deal with the contradictions between her roles as wife and as daughter-in-law. As a wife, her status complements that of her husband; as a daughter-in-law, her status supplements and competes with that of her mother-in-law. This may cause severe conflicts in some households, as when mother-in-law and daughter-in-law disagree on how money should be spent. Women have a great deal of control over economic matters within the household. In Kriovrisi, the mother-in-law can retain this control even after her son has married and, in some cases, even after her own husband, the nominal household head, has relinquished his power or has died.

A few households in Kriovrisi were notorious for fights between mother-in-law and daughter-in-law. In one of them, Argorou, the mother-in-law, who was 78 years old and half-blind, ended the argument by gratuitously proclaiming, "All right, I'll leave. Just give me some bread and cheese and I'll go away. Don't worry about me." Her daughter-in-law, Olga, was put in the position of having asked Argorou to leave, which she had not done. Olga came to tell our landlady the story of the fight. After she left, I asked Evanthia why these fights happened. Smiling slyly, she said, "Her husband likes his mother too much." We talked some more about the problem, and it emerged that Olga had no choice, for village women view a bad husband or mother-in-law as just the luck of the game and feel they can do nothing about it. Evanthia sat silent for a moment, then said, "But, still, it's not right. Olga should be treated better than that. Even a daughter-in-law is human."

In many cases, the women live together amicably and provide company for each other in a way that prevents their work from becoming the alienating experience it can be for women living in nuclear families like our own. The division of labor among females also permits the multitude of tasks to be done efficiently. In addition, within the context of her role, a woman has much to look forward to, for one day her life will be easier; she will have a daughter or daughter-in-law to do the heavy work, she will cook, she will play with her grandchildren, and she will have the right, as a mother-in-law, to sit and do nothing, if she wishes, but talk with old friends for an afternoon hour.

There are many resemblances be-

tween this situation and that of other societies, including our own industrialized, urban society. The sexual division of labor, based on the long maturation period of human offspring, is a social adaptation, probably as old as human society, that has enabled human groups to survive. Since females must care for the young, their mobility is restricted. While males can range farther afield, females stay fairly close to the place of residence, caring for it and also engaging in food-getting activities that do not take them far away. A division of labor among females, such as described for Kriovrisi, allows greater efficiency in the pursuit of these activities. Likewise, among males who engage in various means of livelihood, cooperation and specialization between two or more males also renders food-getting more efficient.

Changes are slow to take place in this division of labor, which underlies so many other social patterns. Despite time- and energy-saving devices, such as wood-burning stoves and, more recently, propane gas burners instead of fireplaces, liquid dish detergent (as Evanthia said, "Things are much easier with 'Thrill' "), and ready-made clothes instead of homespun, the role of women seems to have changed little since the nineteenth century, at least as it is portrayed by the old women of Kriovrisi today. A woman's basic tasks are the same, the separation of male and female worlds continues, and the working of wool continues to absorb any excess time or energy.

It is only in cities that change can occur. There are girls, whose parents were born in Kriovrisi and later emigrated to a city, who now go to secondary school and the university. One such girl, the daughter of an Athens cheese merchant, went to a French private school there and attended law school. Another attends the university in Ioannina. The urban environment provides jobs suitable for women, such as teaching positions, secretarial jobs, or sales positions. In Kriovrisi, there is room for only one teacher (a male) and no business concern needs women.

In the city, major technological changes enable women to spend much less time and energy at household tasks. All clothes are ready-made. Running water and electricity, laundromats and prepared foods decrease much of the household labor. These changes permit the nuclear family to predominate, for one woman can do all the necessary tasks with time to spare.

In Greece, as in the United States, women in cities are beginning to be discontent with, and to question, traditional roles. Maria, a 45-year-old woman from Kriovrisi, lived with her husband in Ioannina, a city of some 40,000 people, and had a 15-year-old daughter studying to be a French teacher. Maria felt that "in Greece, women have no value; their work is considered to be worthless, and the work itself is hard." Her husband disagreed, adding that "perhaps village women have to work hard, but it is different in the city." Perhaps the difficulty Maria felt, living in the city, was the loneliness of solitary household work; perhaps it was also her awareness of the increased opportunities that were open to her daughter.

Urban women, however, feel pressure not to work outside the household. Many men feel dishonored if their wives work, and women feel that once they have children they would be neglecting their duties if they went to work. These attitudes reflect both an economy unable to provide adequate work even for its male population and the prevailing ideology of appropriate male and female roles. In 1967 a popular song, "The Girls Who Go Two by Two," dramatized the confined role of Greek women:

> Young girls in pairs
> passing by,
> shy and embarrassed
> the young girls hurry by.
>
> Young girls looking in the
> mirror, the mirror.
> Every night secretly they watch
> themselves getting older
> with fear in their hearts.
>
> Young girls are so so pretty,
> so so unlucky.
> You see the ugliness of
> their parents.
> They'll pay for it very dearly.
> One day, dejected, they'll
> stand before the altar.
> Their mothers will cry,
> relatives, in-laws.
> The unlucky girls have
> nothing more to say.

In Kriovrisi, what little questioning there is does not go far. Zoe, 23 years old, lives with her husband, her mother-in-law, and a year-old daughter. She is much put-upon by both her husband and her mother-in-law. Her husband yells at her at the slightest excuse and continually gives her orders. Her mother-in-law constantly criticizes her work. One winter day after a heavy snowfall, the stove, for some reason, would not work. We were all cold and uncomfortable. Zoe's brother had been married a few days before, and she wanted to visit him and his bride on the other side of the village. But her mother-in-law forbade her to go. Her baby was crying a lot because she had just been weaned. In exasperation, Zoe said to me, "Don't ever become a mother. It's not worth it." Six months later, when the weather was warm, I went to visit her. Zoe's daughter was playing on the floor of a sunny room in a new house. Zoe told me she was pregnant, and although she would have preferred to wait another year, she was very happy about it. "You should have children," she said. "But you told me never to become a mother," I reminded her. "I didn't mean it," she said. "We should marry, have children, and raise them. What else are we put on earth for?"

A young woman's family name
household skills, beauty
and—especially—her dowr
are all weighed when he
wedding is contracted
Many marriages are arrange
by the parents of th
bride and groom

Sky Reporter

Fireball Alert The good ship Earth is even now hurtling along on a collision course with a cluster of unguided missiles weighing several tons apiece; contact is expected sometime during the weekend of April 24. No one expects a catastrophe, but with a little bit of luck some of us may see some spectacular pyrotechnics in the sky.

The missiles are large meteoroids, the kind that become fireballs when they blaze through the atmosphere, shining as bright as the full moon until they break up in a rumble of sonic booms. They are not as dangerous as they look because slamming into the atmosphere at 15 miles per second or more tends to burn them up.

A fireball may be seen at any time, of course. Apparently a fair amount of asteroidal debris remains in interplanetary space, and the earth continually sweeps up chunks along its orbital path. Most fireballs are never seen: they occur over uninhabited land areas, over heavy cloud cover, or over areas of ocean where no ships happen to be passing.

Normally, seeing a fireball is just a matter of luck. Should you be outdoors on a clear night when it occurs, you can't miss it. But on the weekend of April 24, you should have better than a random chance.

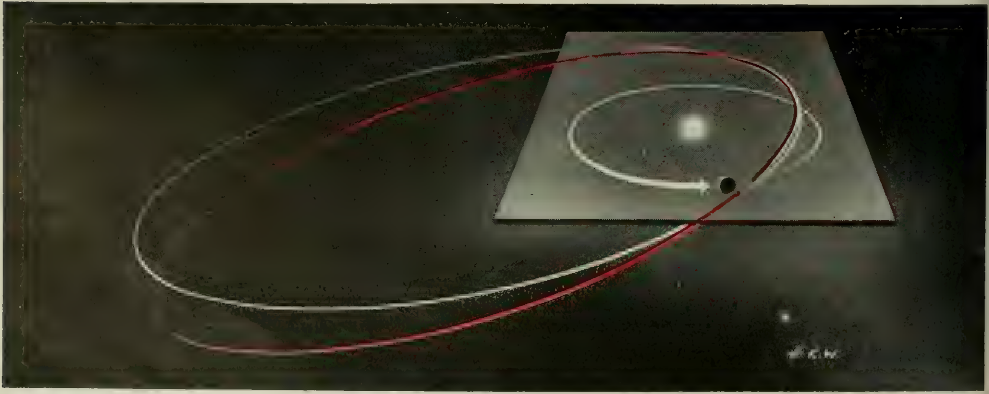
The diagram below illustrates the orbits of two fireballs that took place seven years apart. The orbits look very precise, but the range of probable error in the computation of each is more than the difference between them. It seems entirely possible that the two fireballs had a common origin, from either an asteroid collision or the breakup of a comet, and that both had the same orbit. If the two were in fact common objects, then it is likely that there may be more strung out in space in the same orbit.

The fireball orbits intersect the orbit of the earth around the point where the earth is every April 24. The meteors catch the earth from behind and below; this simple picture is modified, of course, by the earth's gravitational field.

The higher of the two orbits is that of the fireball that flashed across New Jersey shortly after 8:00 P.M. on April 23, 1962. It was first spotted over the Atlantic east of Barnegat Bay, and more than 80 observers, some in New York and Pennsylvania, reported seeing it move northwest over Asbury Park and Morristown before burning up.

The lower orbit is that of a fireball that moved northwest over Wales and northern Ireland one hour after sunset on the night of April 25, 1969. More than 300 people saw it descend from 75 miles up, where it first became visible, to about 10 miles, where it disappeared. Pieces, the largest weighing about 11 pounds, were found at two sites in Ireland.

A crescent earth is shown approaching the point where its nearly circular orbit around the sun is intersected by the much more elliptical orbits of two recent fireballs. The meteor orbits come up from beneath the plane of the earth's orbit, circle above it, and go under again on the far side. The color line is the 1969 fireball orbit; the white, 1962.



Writing in the *Journal of the British Astronomical* *sociation*, Keith B. Hindley, director of the associ- on's meteor section, and Howard G. Miles, director the artificial satellite section, contend the two fire- ls could well have had a common origin and that refore more falls could occur in the future. They ntinue:

"The period April 23–26 should be covered in the ure by amateur and professional groups in the hope recording further associated fireballs and perhaps teorite falls."

otting an Invisible Black Hole A. G. W. Cameron, 10 first gave the name collapsars to black holes in ace, may have found one in the northern constella- n Auriga.

The problem with black holes is that there is no way see them or hear them. They are stars that have llapsed, suffered what is called an implosion. The atter in such stars has been squashed together into rms unknown on earth, matter so dense that its grav- tional field prevents any kind of radiation from es- ping. You couldn't see one if it was right next to u; if you shone a light on it, the light would simply sappear into the black hole.

We can find such objects, however, by noting their ects on nearby objects that we are able to see. Just we can detect otherwise invisible planets circling ighboring stars by studying their effects on those ars, so we can locate black holes by noting their fects on nearby visible stars. The easiest such case is binary system with one normal star and one collap- r, and Cameron believes he has found just such a ar.

The star is Epsilon Aurigae, a naked eye variable out three degrees southeast of Capella in Auriga. psilon Aurigae is an eclipsing binary, a double star stem in which—as seen from the earth—one star riodically crosses in front of the other. When we ok at Epsilon Aurigae, we see the yellow supergiant rimary dim from magnitude 3.5 to 4.5 for a couple f years every 27 years when the secondary passes in ront of it.

Working with such information as the luminosity of ie primary and the period of the system, theorists ave calculated that the primary has a mass about 35 mes that of the sun, the secondary a mass about 23 imes that of the sun, and that the two are separated y about 35 astronomical units (3¼ billion miles). The calculations also show that the secondary should be at least 40 percent as bright as the primary. But it can't be seen at all; therefore, the reasoning goes, it must be a very unusual star.

The eclipses are unusual, too, because the light dims steadily, then remains remarkably constant for 330 of the 700-plus days of the eclipse. The eclipsing body has to be about 12 astronomical units (a billion miles) across. Because light from the primary comes through it, without color change and without being polarized, theorists have shown that it can only be a semitransparent disk of solid particles larger than the wavelength of light. The particles are heated as they absorb radiation from the primary; the resultant, unusually strong infrared radiation was detected in 1964. The disk apparently forms as particles are captured and go into orbit around the secondary.

So in Epsilon Aurigae we have a massive body, with a gravitational field so strong that compression alone should raise its temperature to thousands of degrees: a temperature at which it would be easily visible. And yet it is invisible. This same object is surrounded by a disk of particles extending for millions of miles.

Reporting his findings in the journal *Nature*, Cameron says the mass of the invisible secondary is far too large for it to be a stable white dwarf or a neutron star. The only possibility left, he says, is that it is a black hole.

In the same issue of *Nature*, Richard Stothers, who has worked with Cameron at the Goddard Institute for Space Studies in New York, offers a second black hole candidate. The yellow supergiant 89 Herculis also exhibits an unusual amount of infrared radiation. In the past, this has been explained as the result of a spherical shell of particles around the star. But it is difficult to explain why only 89 Herculis among all the yellow supergiants should have such a shell.

Stothers proposes instead that an invisible secondary, a collapsar accompanied by a disk of small particles, orbits 89 Herculis. The observed infrared excess comes from these particles, heated by the primary star.

If the suspicions of Cameron and Stothers are correct, we have actually found black holes, only a couple of years after the detection of pulsars meant we had found the hitherto theoretical neutron stars. Learning how to study black holes once we have found them will be something else again. JOHN P. WILEY, JR.

Celestial Events

From full moon on April 10, the moon begins to wane as it enters the morning sky, passing through last-quarter on the 18th and reaching new moon on the 24th. The early crescent becomes visible in the evening sky during the last week of April and grows to first-quarter moon on May 2. Full moon occurs on the 10th, and the moon wanes thereafter.

The great display of morning planets of the winter and early spring is beginning to break up, as Venus dims and moves closer to the sun, and Jupiter brightens and approaches opposition. Venus can still be seen, low in the east southeast, but quickly fades in the dawn. Jupiter rises in the early evening, well before midnight, and is in the southwest by dawn. Mars also remains in the morning sky, still brightening among the stars of Sagittarius. It rises a few hours past midnight and appears in the south at dawn. Only Saturn remains in the evening sky, as Mercury, visible early in April, moves close to the sun. Saturn is low in the west at sunset and sets just about at the end of evening twilight. It may be hard to find in May.

April 16-17: The moon moves through Sagittarius in the morning sky just a day before reaching last-quarter, passing Mars in doing so. Mars is to the left and below the moon on the morning of the 16th, to the right and above the moon on the 17th.

April 19: Mercury is at inferior conjunction, passing between earth and sun as it goes from the evening to the morning sky.

April 22: The relatively weak Lyrid meteor shower reaches maximum today. While the single observer rate is only 15 meteors per hour, there should be no problem with moonlight for the after-midnight observer. The thin crescent moon, rising just before dawn, is an easy guide to Venus, which will rise about half an hour later, below and to the left of the moon.

April 26: You may still be able to see Saturn just below the early crescent moon in the evening sky tonight. Don't expect to see the planet again, however, until late June, when it will be a morning star.

May 5: The Eta Aquarid meteor shower, so named for the location of its radiant, near the fourth magnitude star Eta in the constellation Aquarius, reaches maximum today. Not a very productive shower, about 20 meteors per hour per observer, but the meteors are swift and bright. Expect a gibbous moon in the sky for several hours after midnight.

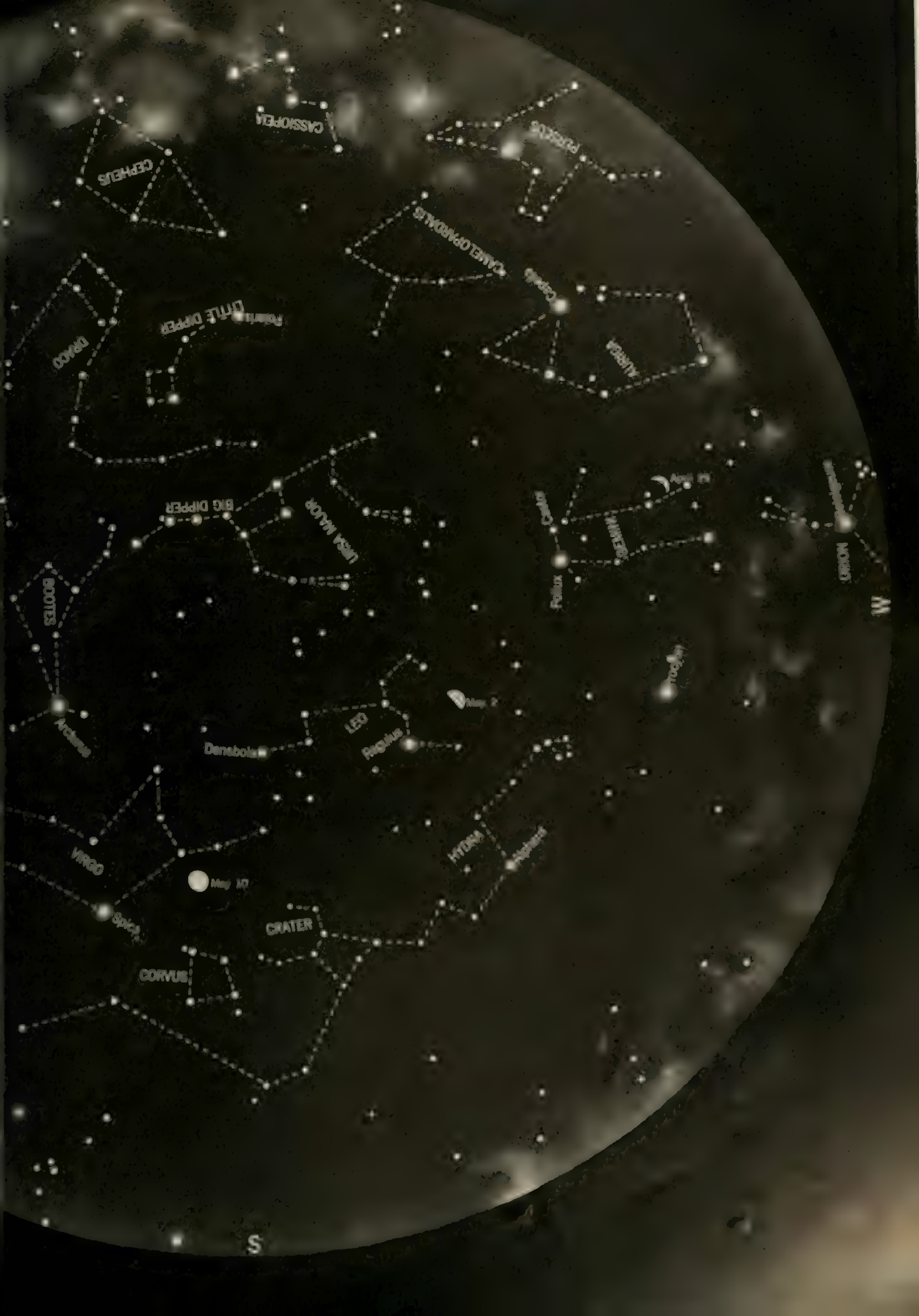
May 11: The waning gibbous moon will pass very close to the red star Antares, in Scorpius, about 9:00 p.m., EST, tonight. The bright object higher and to the west (left) of the moon is Jupiter.

May 15-16: Prepare this evening to watch for the occultation of Mars in the morning sky of the 16th. The waning gibbous moon will cover the planet for more than an hour in the eastern and central parts of North America. Times will vary, so it would be wise to begin watching about 3:45 a.m., EST, in the eastern portions of the area, about 2:30 a.m., CST, in central regions.

Thomas D. Nicholson

★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky. The map is for 11:25 p.m. on April 15; 10:20 p.m. on May 1; and 9:25 p.m. on May 15; but it can be used for about an hour before and after those times.

E
Rasalhague
OPHIUCHUS
SCORPIUS
Jupiter


CASSIOPEIA
PERSEUS
CEPHEUS
CAMELOPARDALIS
Capella
AURIGA
LITTLE DIPPER
Polaris
DRACO
BIG DIPPER
URSA MAJOR
April 28
Castor
GEMINI
Pollux
Betelgeuse
ORION
W
BOOTES
Arcturus
Procyon
May 2
LEO
Regulus
Denebola
HYDRA
Alphard
VIRGO
May 10
Spica
CRATER
CORVUS
S

Continued from page 51

One man, possibly a companion of M. Antoine, nearly lost his life, and two men accused of misleading him were jailed. According to Benech, presumably from Pourcher, on August 16 three men, the hero Chastel and his two sons, let one of Antoine's keepers get mired, had the audacity to laugh at him, and then when he attempted to vent his rage on one of them was menaced by the other two with their guns. However, the hour was at hand.

On September 21 M. Antoine went with his company to the dense thickets belonging to the nuns of the Royal Abbey of Chazes. His dog handlers had driven several wolves there, including a very large one. He brought in beaters, his gamekeepers, and anyone he could get who had a gun. When the dogs were put in, he himself took the most likely looking runway. He had not been there long when he got a broadside-on shot at a big wolf at forty steps distance. The charge he had loaded bowled him over backward, but the wolf was hard hit. Before he could reload, it came for him, possibly in confusion, and Rinchard, a gamekeeper from the estates of the Duc d'Orléans, who was nearest, came in and shot it as it stood ten steps from M. Antoine. It ran again, twenty-five steps into the open, then fell dead.

This was a great occasion and M. Antoine was immediately revealed as a real opportunist. He had the wolf weighed and measured and the figures attested by all the qualified witnesses in the countryside. After that it was examined by a local surgeon, one Boulanger, again in the presence of witnesses, and there were brought four girls and three boys who had been involved in four different attacks, and who solemnly identified their attacker. The surgeon had very little to say. He thought the bones in the stomach were sheep ribs.

One of the girls could do better. She was Jeanne Valet, a nineteen year old, and not long before, when she and her little sister, Thérèse, were attacked by the Beast, she had driven her homemade bayonet deep into its shoulder and sent it off with blood streaming, licking its wound. At the time she had said it was about as tall as a shepherd dog type represented today by the Great Pyrenees a the St. Bernard, so she meant that it was big) a that it had a white throat, a gray mane, and a bla back. The dead animal, as everyone saw, had white throat, and she was able to point out t mark of her bayonet deep in its shoulder. May w not be permitted to read a little drama into th bald restraint of the narratives? There She l (the Beast is feminine in French and was spoke of as Elle, with a capital E). Into the presence o a distinguished officer of the court, who could b counted on to tell her story to the king himself, an of assorted officers and gentry, with a throng su rounding, a peasant girl and her sister were led b their curé to a moment of triumph. "It is She—an there is where I stabbed Her!"

After having been officially exhibited to th agent of the intendant of Auvergne at Saint-Flou the big wolf was taken to Clermont-Ferran There it was examined by M. Jaladon, one of th senior surgeons of France, who made a depositio in detail, which starts out by stating that the bod was already getting a bit high, and then describe in a professionally competent manner an amazin variety of wounds inflicted at various times, as wel as at its death. These could be matched by the re ports of others, in addition to that of courageou Jeanne who had wounded it, and left no doubt tha it was a man-eater. He also tried to preserve i "with the liquor suggested by M. Buffon."

M. Jaladon remarked that the wolf was huge. In fact it weighed 130 pounds while fresh, was 32 inches (0.864 meters) high, and 5 feet 7½ inches long (all measures contemporary French). The length measured by M. Jaladon was 5 feet 10 inches and 6 lines (one meter 900 mm.). The body length was one meter 433 mm., and the skull length 350 mm. Metrical dimensions were transposed by Fabre. Such a wolf would be called big in North America, and for Europe it is huge.

In spite of the acknowledged imperfections of M. Jaladon's embalming, which started a little too late, M. Antoine's son rushed the body to Paris, where it was seen by the queen and then by the whole court. Antoine senior remained behind to get the female and two cubs, which had been seen during the hunt. The Abbess of Chazes insisted that none of this demoniacal breed should be left. This was successfully accomplished, and he submitted a bill of 782 livres expenses, fully documented, to the intendant of Auvergne. Captain Duhamel had left one several times as large, what with hay for the horses and, presumably, drinks for the dragoons. Then M. Antoine left for Paris, Cross of St. Louis, and a 1,000 livres pension. Ie and his son made a tidy sum exhibiting the big olf as long as its remains could be held together, nd its skin, despite putrefaction, was mounted. Vith that, his pension, and his various awards, his ortune was made—a real killing.

At first, discordant voices that arose during ese proceedings were not listened to at all. There ere always those who claimed that the deaths had een caused by some sort of werewolf, and in spite f its old wounds, they refused to believe that the Beast could be killed. M. Antoine had left in Noember, and so far as French officialdom was conerned, the Beast, his mate, and cubs were all dead.

When, on December 2, two chil-ren were attacked at Bessyre-Sainte-Mary. In ollowing weeks there were more attacks and a kill, nd in February of 1766 a footprint larger than hat of the dead Beast was measured. In spring he dreadful register of burials of child victims tarted again, and so did the hunts, this time withut official help. The number of victims was maller but the terror revived. As the new year vore on the second wolf, for such it can only have een, grew bolder. He had averaged only one a nonth, but in April he took six and in May five. Even at 200 years distance, one cannot help being haken by the stark tragedy set down so simply in he parish burial registers. One such now would nake every headline in this continent.

If the crown now took no notice, the States-Geneal of Languedoc had to, because they were near at hand. They posted bounties and the local gentry started hunts that were comparable to hunts caried out for sport, but held much oftener. Poison was tried again on a large scale, without result. With poison the wolf is the last to be exterminated, being preceded by a host of lesser fur-bearers. Before the end of the year three more victims were dead. One wolf kills less than two, and the toll at first was not as high as it had been. However, as spring came again the death toll rose sharply, almost to its old level. Peasants were still subject to the order of the intendant to make themselves available for drives as required.

The end came in the Saugues area of Gévaudan on June 19, 1767, in a hunt directed by the local

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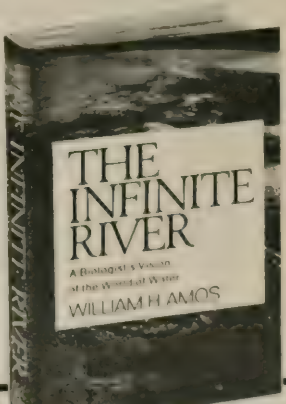

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lord, the Marquis d'Apchier (in one place referred to as "M. le Comte d'Apcher"). A married peasant from the chief village of the parish of Bessyre-Sainte-Mary, Jean Chastel (la Masque), Pourcher's hero and relation and an excellent hunter although sixty years old, was on watch while the marquis hunted his hounds. A great wolf was put out to him and fell to his shot. It was finished off by the marquis' hounds, being evidently too well hit to do them any injury. In the account of this slaying Pourcher's aunt really let herself go. Before the hunt the marquis is said to have first organized a pilgrimage to Notre Dame de Beaulieu, where Chastel, released from prison, had his bullets blessed. On his watch, when the Beast came, he was reading the litanies of the Virgin. He calmly folded his book, put away his glasses, and shot it. Fabre, who was a reverend abbé himself, was evidently too good a historian to repeat this, even though it might have appealed to his religious feelings.

D'Apchier, whom Pourcher evidently describes as the châtelain of Besque and only nineteen years old, wished to emulate M. Antoine, and he had the wolf measured, examined, and embalmed by the same surgeon, Boulanger, also known as la Peyranie, who had examined the first wolf. This poor man merely replaced the entrails with straw. By the time it got to Paris it was much too high for the royal nostrils, so the great naturalist Buffon was delegated to examine it, after which it was buried. Buffon merely stated that it was an enormous wolf. It was described as reddish, with a very large head and a long muzzle.

We owe to the unhappy Boulanger and his witnesses the fact that the identity as a man-eater was established—the stomach contained portions of a young girl, its most recent victim. A contemporary, the Abbé Trocellier, tells us that it weighed 109 pounds, smaller than the other. The first wolf was also said to have been long muzzled.

That was it. The Abbé Fabre cites four major histories of the episode, besides Pourcher's book and Berthet's novel. He estimates 120 to 150 persons attacked, and I tally 64 dead from his records, but Delperrie de Bayac concludes that there were at least 80, possibly 100, and found 34 deaths in parish archives still extant. Fabre is not always clear whether the victim died or not. Matheson, who uses still another source, says that 74 wolves were destroyed in 1764 alone by hunters who were after the Beast; that would be mostly Duhamel and his dragoons. Menatory cites 2,178 as having been killed in Lozère alone between March 15, 1740, and April 30, 1773, or 66 per year, which is consistent, apparently based on records. Fabre leaves no doubt that many were killed during the whole period of the Beast, but he does not say how many. One should add that Chastel, who was a peasant and not a royal porte-arquebuse, and who had the misfortune to kill the Beast after the Beast was officially dead, got only 72 pounds. For him it was probably quite a fortune. Evidently the Bishop of Mende also provided a gratuity for all who were on the final hunt—26 pounds each as given in Delperrie de Bayac.

Thus, after a long terror, huge expense, and dislocation of the life of a province, were killed the wolves that killed men. Wolves they were—not hellish monsters as some thought. Delperrie de Bayac disposes of other explanations. But were they ordinary wolves? Many said no. The common belief was that they were possessed by demons, which Pourcher evidently believed. The idea is believable if one accepts all the traditional premises of religious groups, and it is not surprising to find it urged. After all, there is no other instance of human death from wolves in which it can be so positively asserted that the wolf did not have rabies. During comparable periods in the same time segment in France, many persons were killed by rabid wolves and by rabid dogs. This was accepted as part of a known pattern, and although every victim had a funeral and entry in the parish register, there was no terror. The insistence on demoniacal possession is a compliment to the wolves. Normally, the peasant in contact with nature could not have considered the wolf a menace to man. The evidence is a culture featuring twilight herding by unarmed children, in a land where drives, in six months, may have killed 74 wolves, and certainly killed a large number.

Now the historian's job has finally been done by Delperrie de Bayac and we come to the questions. One is, how many animals? Fabre goes for two, but Delperrie de Bayac shows that two mates were killed and that some of the wounds inflicted on other wolves may have been fatal. There is no evidence of joint or pack efforts in any attack, so the bitches may be ruled out. Delperrie de Bayac sees evidence of three animals in the distribution of attacks in time and space. Maybe, but the certikilling of two certainly ended the reign of or. Having reviewed the story, I should, I suppose, make a factual summary and conclusions.

ne can say:

The wolf, *Canis lupus*, is widely distributed in the Old and New Worlds and until recently was generally abundant. It is still common in my home area.

No humans are known to have been killed by wolves in North America.

There are many instances of human deaths by wolves in southern and central Europe and central Asia.

In many instances the wolves causing such deaths were rabid. Except for the incidents involving the Beast of Gévaudan, it is possible that all the wolves involved were rabid.

Rabid wolves and nonrabid wolves attack the face and neck of victims and rabid wolves may kill directly and even devour flesh.

In the years 1764-67 wolves in the Gévaudan area of central France attacked more than 100 persons, killing possibly 100, and eating portions of most of these. The history is fully documented and authentic. Two wolves killed were examined officially.

The wolves in question were not rabid.

Both wolves were mated, one mate having cubs with her, and acted in a normal manner, apart from preying on humans.

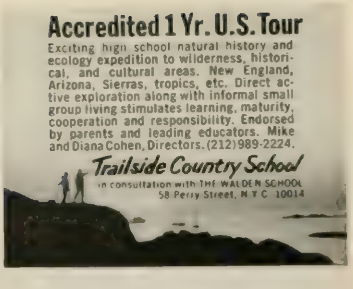
Most of the victims were children engaged in herding animals. Adults and many children who put up a resolute defense escaped with their lives.

The two wolves were very large, as large as the largest geographical races of their species and huge in comparison with the average European wolf. The color markings were also abnormal, one having a white throat and the other being reddish enough to cause comment. There were evidently other abnormal features as well.

European cultural patterns in herding and the attitude of persons in wolf-inhabited areas show that the presence of wolves was not considered dangerous and attacks, even on children, by nonrabid wolves were not expected.

2. The exceptional behavior of the wolves in question caused terror because it was unique in the experience of the people affected. It remains unique in the history of the species.

Conclusions? What can one conclude? Evi-ently rabid wolves do bite men, and some non-bid wolves once bit a great many humans, mostly ildren. Could it happen again? One must admit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that any wolf would be a formidable antagonist for an unarmed man, let alone child, and some wolf might conceivably find that out. In this age of rifles and helicopters the marauder would soon be felled. The education of a wolf anywhere in the world is such that he learns to fear the faintest whiff of man-smell. The generations of wolves that failed this test left few of their genes in the present wolf population. Yet I have visited an area in the subarctic tundra where little birds fled at great distances, but wolves came fearlessly up to man whom they had never before encountered. Once, in the Yukon, where all wolves are the size of the Beasts of Gévaudan, I was returning to camp by night over a snowy trail when I came suddenly on the steaming beds of several of them. I continued not even curious, because at the time I had sixteen years of familiarity with wolves behind me. Before long, however, I realized that even if I was not curious, the wolves were. Two fresh tracks cut the trail in front. Although I could not make them out they were sometimes in front, sometimes behind sometimes on one side, and sometimes on the other After about three miles they wearied of the game and I knew that they were no longer with me. I was hungry if they were not, and in a hurry, and I just kept on going without giving them much thought When a ruffed grouse burst out of the snow at my feet I may have jumped an extra inch or two, but I can truthfully say I was not what some writers have called "edgy." At the time I had never read *La bête du Gévaudan en Auvergne*. All the wolves I have since encountered have fled precipitously and I still sleep as well in a tent in the Canada wilds as I ever did, and as I hope all readers who have the opportunity will also do.

After all these considerations one is led back relentlessly to the explanation commonly accepted at the time—that there was something unusual about those wolves. Here I depart from Delperrie de Bayac, who was content to prove simply that they were wolves in the conventional sense. Consider the facts: The two examined were abnormally large and abnormally colored. The shape, too, was wrong in the eyes of men who had seen dozens of wolves killed in the course of this one campaign. They were also, shall we say, abnormal in their hunting habits. Do these facts mean anything? Delperrie de Bayac thought not, but we may have more experience in some areas than he.

Wolves may be black or white, as well as gray, and the mane of a normal gray wolf is darker than the rest. A clear white throat is a dog character. Reddish color is not normal in a timber wolf, although it is found in the so-called red wolf of the ern United States, which comes in two phases, nd black. Some zoologists call it a different es. Some true timber wolves have a rufescent but the description given to the smaller of the Beasts, like the white collar of the larger, does ing true. Both do ring true for a wolf-dog hy- . However, such hybrids are literally unknown ture. Petrov (1933) says that wolves hybrid- eadily with dogs in captivity and in the wild, the latter statement is made very casually and out any supporting data, and I feel that it is ely a repetition of popular belief. The husky of today is often of mixed blood, but the wolf no part in the mixture. I have traveled exten- ly in the north and at various times had in my ls the wildlife administration of the North- t Territories and of the province of Ontario, I have never heard of a natural dog-timber f cross. It can easily be made in confinement, ever, and a few have done it as a stunt. Some e actually driven captive wolves in their teams.

Often what we do see is a natural -coyote hybrid, especially in southern Ontario, re coyotes are scattered and the females may red by dogs in the absence of their own kind. provincial administration has handled hun- ds and has also raised wild hybrid litters. The tern is fairly clear. In a first-generation cross may get hybrid vigor, that is, the offspring are ger than either parent. This is lost in successive edings and back-crosses, but the second genera- may also be large. The first-generation hybrid also wolflike in its general appearance, even ugh the dog parent may have been piebald and eared. The wolf appearance is dominant. In- eding of the second generation brings out the ent doggy characters. The hybrids are also ckish or reddish, usually uniformly colored, but asionally showing white tail tips or other white rks.

So far as I know, hybrid vigor is not general in e dog-wolf hybrids produced in captivity, but e other results are the same—usually a dark, lflike animal. The dogs used in these crosses ve always, to my knowledge, been of spitz orthern) types and may carry enough of the me genes as the wolf that hybrid vigor is not

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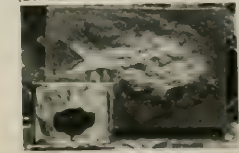

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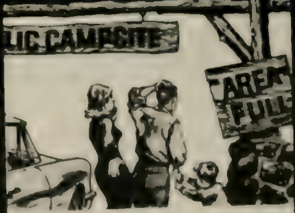

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produced. It might well be different if the were, say, a Cevanol shepherd. Certainly, if history of other animals is any guide, some d wolf crosses could be expected to produce hyb vigor. The abnormal coloration of the two Bea considered with the fact that they were abnorm in other respects, leads me to believe that th were really unique in the history of their kin natural first-generation dog-wolf crosses with brid vigor. I should add that the natural d coyote crosses that we have to contend with more cunning than dogs or coyotes, not the le bit tame, and far more destructive than the w parent, with less fear of man. The thing fits. U fortunately, apparently neither M. Antoine nor Buffon saved us a skull. The National Museum Paris, according to Delperrie de Bayac, destroy the skin of M. Antoine's wolf at the beginning this century after it had shed all its hair. Was the a skull? If it is gone, no conclusive judgment c be made. It is like the contemporary theory demoniacal possession. After all, who knows? Delperrie de Bayac's bibliography suggests th someone in France may have had the same idea I, but I cannot, from this distance, check out t reference to make sure.

I should add that some time ag I saw a World Health Organization bulleti containing articles on rabies, including one b M. Baltazard, M.D., and M. Ghodssi, M.D from Iran (1954). Both authors are members o the Pasteur Institute in Tehran. They accept ac counts of attacks by wolves as being by nonrabi animals and describe one that puts the wolves o Gévaudan to shame! With all due respect to th learned doctors I should prefer to have both th attack and the absence of rabies in the wolve documented. After all, anyone who believes th Toronto press would have believed that a fe years ago an armed conservation officer was attacked by a wolf near the city. There was a wol (coyote) and a conservation officer, but there th factual part of the story ends. The urban dwellers typical ignorance of the countryside greatly increases my skepticism toward secondhand reports from Tehran of wolf attacks in remote Iran.

There we have it. Anyone who is the least bit erested in wolves must, especially if he is a wolf ·er, confront the Beast of Gévaudan. Now, ınks to Delperrie de Bayac, we have a dispasnate history by a man whose record shows him be a lover of wolves, who has kept two in capity, and who is interested in seeing the remnant France preserved from extinction (see also aufort 1968, Merlet 1968, and Menatory 68).

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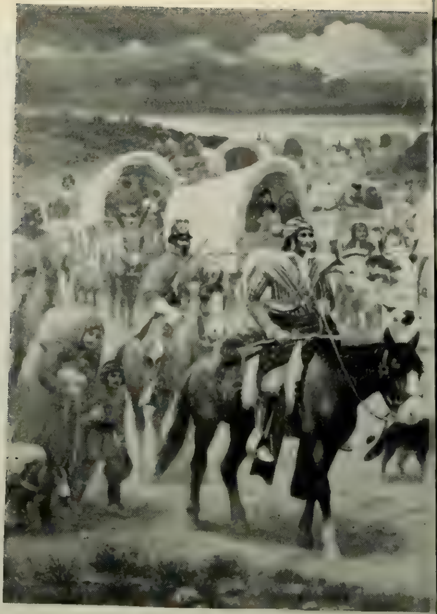
Retracing the Trail of Tears

by Nancy O. Lurie



Cherokee Tragedy, by Thurman Wilkins. *The Macmillan Company, $10.00; 398 pp., illus.*

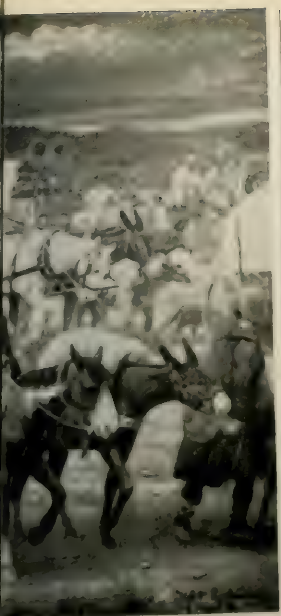
The story of the "Trail of Tears," the Cherokee trek from their eastern homeland to Oklahoma during the years 1837 to 1839 has been told many times and from many points of view. Thurman Wilkins opens his narrative with the June, 1839, murders (or executions, a matter of strongly divided opinion among the Cherokee) of three Indians: Major Ridge, his son John, and his brother's son, who had taken the white name Elias Boudinot.

The elder Ridge, commissioned in the War of 1812, had fought beside Andrew Jackson and was convinced that Jackson had only the Indians' best interests at heart. Illiterate and virtually monolingual to the end of his life, Major Ridge was, nevertheless, a successful planter in the southern, slave-owning pattern. He saw to it that his son and young Boudinot received the finest education possible so that they might serve their people. Following initial schooling near home, the boys were sent to a missionary training academy at Cornwall, Massachusetts. In time both brought home white brides. Reviled for their presumption as crude savages by racist New Englanders, they were memorialized, with equal inaccuracy, as simple and noble sons of the forest in the sentimental poetry of the day.

These two highly intelligent and well-educated men, along with the elder Ridge, were as much products as leaders of the astonishing Cherokee cultural florescence that, in the space of a generation, turned a tribal people into a nascent modern nation with its own constitutional government, laws, towns, roads, businesses, and newspaper. While the Ridges, Boudinot, and a few others were exceptional in their standard of living, they shared with the majority of Cherokee those customs and attitudes derived from native tradition that welded the group together as a people desiring their own national identity. Wilkins tends to overlook this strength of cultural persistence, seeing the Cherokee's achievements as imitations of white standards rather than as uniquely Cherokee adaptations of innovations from white culture. However, he does note that common allegiance and mutual understanding between the most educated and the most traditional Cherokee were made possible by the incredible intellectual feat of one man, Sequoyah. His invention of an eighty-six-symbol syllabary led to the entire Cherokee nation becoming literate in its own tongue practically overnight, relieving it of dependence on English, which could be written, as the official language of state.

But the Cherokee's amazing progress was denigrated and resented whites covetous of their land. C group of Cherokee gave up struggle as early as 1809 and sc out, settling in Arkansas. The r parted reluctantly with a good deal their territory but retained th Georgia holdings, vowing not to s another foot of land. The Ridges a Boudinot were particularly oppos to land sale. The old major journey to all the Cherokee settlements a homesteads, inveighing against t blandishments of the federal gover ment and the threats of the state Georgia to induce the Cherokee sell their land and move west.

Like that of all Indians at the tim the Cherokee's legal and politic status was equivocal. Their land within the boundaries of Georgi were under federal jurisdiction bu they were not citizens of the Unite States or protected by the laws o Georgia. When Georgia declared th Cherokee's government null and voi and proceeded to appropriate prop erty and harass the Indians and thei missionary supporters, the Cheroke sought recourse before the Unite States Supreme Court. In 1831 and 1832 Chief Justice Marshall handed down decisions favoring the rights of the Cherokee Nation in principle, but he could offer no means of enforcing the decisions. Jackson continued pressing for removal. By 1834, the Ridges and Boudinot became con-



'rail of Tears, by Robert Lindneux

ed that the situation was really eless. Reversing their stand com- ely, they now argued for the ne- sity of immediate removal to get the price possible for the Cherokee l before it was simply taken by whites and they were driven off.

n this, however, they were opposed the Cherokee's elected principal ef, John Ross. While of more white n Indian ancestry and able to ak Cherokee only haltingly. Ross s married to a full blood and ared a life-style and outlook more sically Cherokee than the Ridges'. argued for procrastinating on aty talk until Jackson was out of ce, recognizing, as the elder Ridge uld not, that Jackson was no friend the Indians. The issue became one either remaining attached to the erokee homeland or maintaining nation and its achievements intact moving west. The Ridges were nvinced that remaining in Georgia ould mean the destruction of the erokee as a people. The Treaty of ew Echota, Georgia, was signed in 35 by the leaders in the Ridge fac- n and provided what was deemed a ir price for the land and its im- rovements as well for proper trans- rt of the people and their goods.

The Ridges and the few other pros- erous people removed themselves to klahoma in relative comfort shortly fter the signing. They immediately stablished thriving homesteads and

Earth Day, circa 1870

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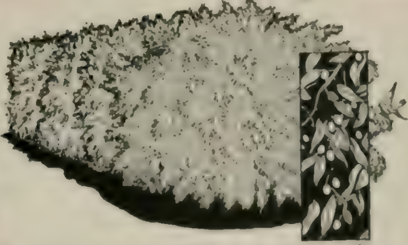
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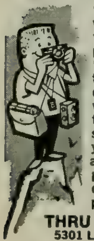

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businesses and placed themselves under the 1809 "Old Settlers" government, which had been modeled after that of the Cherokee Nation in the east but lacked many of its refinements.

Meanwhile, Ross's forces resisted removal, and when finally they assembled or were forcibly rounded up and began moving west, a combination of maltreatment by undisciplined soldiers, bad weather, and epidemic diseases resulted in the tragedy known as the "Trail of Tears." As the pitiful survivors began arriving in Oklahoma, the Ridge faction blamed Ross for bringing disaster down on the Cherokee people. But those who had traveled the Trail of Tears blamed the Ridges and Boudinot for the whole idea of the land sale and removal.

Ross was still principal chief of the Cherokee Nation, and he and his followers insisted the Old Settlers give up their government and accept the eastern constitution, laws, and elected officers. The schism deepened when the Ridges and their followers sided with the Old Settlers despite their earlier talk in Georgia that removal would preserve the Cherokee Nation and its political achievements. Rumors abounded, reinforced by their apparent wealth even after removal, that the Ridges and Boudinot had been bribed to sell the Cherokee homeland, and members of the Ross faction decided to execute them in accordance with the "blood law" traditionally enforced against traitors. The plot was kept secret from Ross, who would have surely opposed it.

The violent deaths of the Ridges and Boudinot evoked counter hostilities. When the factional turmoil finally began to subside, it was revived by the Civil War. The Ross faction fought on the side of the Union while the Ridge Treaty Party and the Old Settlers enlisted in the Confederacy. Wilkins ends the story at this point with the observation that it is fruitless to argue whether Ross was really right and the Ridges should have continued their stand against removal. Actually, history seems to have supported Ross. Wilkins does not mention the Cherokee who hid out in North Carolina, once also Cherokee land, and in time managed to buy land through friendly white intermediaries and have it declared a federally protected reservation. The Cherokee Nation of the 1830's no longer exists in either North Carolina or Oklahoma, but as a group the eastern Cherokee with their own elected officers are considerably better off socioeconomically than the majority of poor, reservationless Oklahoma C
okee whose leadership is in
hands of a minority of wealthy mi
bloods appointed by the president.

However, for the period Wilk
covers, his exceptionally well
searched book is an important con
bution to our knowledge of the C
okee. He has made the best case
that the Ridges and Boudinot w
honorable, sincere men working
what they felt to be the best inter
of their people. While their strat
failed to preserve the Cherokee
tion, they were not tempted by bri
to sell out their people.

*Nancy O. Lurie is professor of anti
pology at the University of Wiscon
in Milwaukee. She has done field w
among Indians of Wisconsin, Neb
ka, and Canada.*

More Reviews

THE HIDDEN SEA, by Douglas Fau
ner and C. Lavett Smith. *The Viki
Press, $14.95; 148 pp., illus.*

Here is a chance for those less adv
turous than undersea, free-lar
photographer Douglas Faulkner a
less knowledgeable than C. Lav
Smith, curator of ichthyology at T
American Museum, to visit vica
ously the depths of the ocean a
learn something of the animal li
that abounds there. This 148-pa
guided tour carries a $14.95 fare.

This quarto is really a picture bo
for adults. Because the seventy fu
color plates are either whole-page
double-page reproductions, most
the subject matter is presented at lif
size or larger. All the photograph
was done underwater at depths ran
ing from one foot to 240 feet. Faul
ner labored seven years and travele
under most of the oceans of the worl
in making this collection.

The subject matter is spectacul
and bizarre, and the close-up photo
raphy set against a dark backdrop
that of a master. The most entertai
ing pictures are those showing a pu
nacious lobster threatening the cam
era lens, a starfish at dinner,
Jonah's eye view of a gaping sea bas
a typical female crab exchanging h

be, a sea cucumber imbibing its own arms, and a blushing cuttlefish caught in the act of ting by the intruding photog- . The most breathtaking shots the iridescent beauty of ca- alabaster nudibranchs, the ed armament of the macelike urchin, and the neon multicol- he party-hat jellyfish.

porting the pictures are nine hort chapters of text. Following roduction that defines life and about the ecology of the sea are six surveys of the in- rate phyla. These are mostly ific descriptions of each group, persed with a smattering of otal lore. The former are accu- but so tersely presented they ne elliptical and of little value; atter have a certain pleasant y that appropriately com- nts the photography. Chapter 8 particularly fascinating dis- n on the subject of cleaning iosis. Certain small shrimps and set up "cleaning stations" "cleanliness-conscious" fish lit- line up (in Saturday morning ash style) to be picked clean of ites and necrotic wound tissue. attract clients the cleaners un- ritualized antics, much like of a circus barker. The last ter is on poisonous animals and s one with a dread of ever going ng again.

y over-all impression of the book ite favorable: it should become a ted possession in many personal ries.

JOHN D. PALMER
New York University

TH AS A WAY OF LIFE, by Roger Caras. *Little, Brown and Com- y, $5.95; 173 pp.*

imitive man hunted for food in or- ler to survive. But he also felt a erence for life that is distressingly ent from the witless, clumsy blood- h that much hunting is today, with nething like half a billion birds mammals falling before the guns American hunters every year. This a mighty "harvest" more than a llion tons of carcass, without allow- ce for those crippled animals that ape to die later of gangrene, fever, rvation, or predators.

It comes as something of a sur- ise, then, to find Roger A. Caras, ll-known television friend of sen- nt life, writing in "the environmen- l decade" with ambivalence about e sporting life as it exists today. ere are all the clever sophistries of

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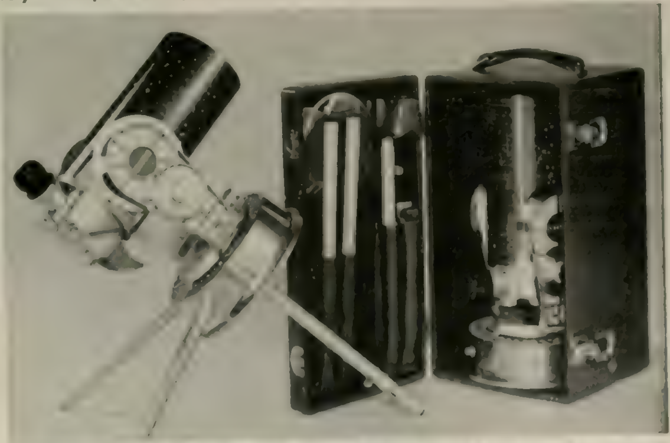

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the shooting fraternity and its entourage, including its services to the cause of conservation, meaning some thirty shootable species out of approximately one thousand North American birds and mammals. Here are warm words—one looks in vain for irony—about the dedication of the career employees of the "conservation" bureaucracies, of whom Rep. John P. Saylor of Pennsylvania has said: "They are dedicated to self-preservation. That is what they are dedicated to." Here is the economic argument of the U.S. Fish and Wildlife Service that every polar bear shot in Alaska adds at least $1,500 to the economy of the state. And Caras celebrates the power of a .300 Magnum and the ecstasy of the kill in terms "Papa" Hemingway might have used.

The annual index for
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INDEX
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The author does not endorse all the positions advanced by those who delight in death and mutilation. Indeed, he is more than a little beastly to them when he writes about game butchers who strafe wild animals from airplanes and drive them into the "slaughter slot" with all-terrain vehicles. But by repeating the arguments, and by giving them currency, while speaking as a man with humane credentials, he endows the hunting rationale with a spurious respectability. In fact, to balance all this—and he seeks what he calls "a balanced viewpoint"—Caras gives scanty recognition to the great majority of Americans who cherish our native game animals as an esthetic or spiritual experience.

"Balance," as defined here, includes acceptance of the anthropological theory that man is not free but was programmed back in the chipped Stone Age, just like *Australopithecus*. So the modern slayer has a built-in compulsion to kill and there is little to be done about it. If he wasn't a sportsman, he would be busy at something else equally insensitive, such as becoming a vivisector or a rodeo cowboy. Thus Caras has made his personal accommodation with hunting on the ground that it is in the genes, which reminds one of what Po
about vice:

> Vice is a monster of so frigh
>   mien,
> As to be hated needs but to be se
> Yet seen too oft, familiar with
>   face,
> We first endure, then pity, t
>   embrace.

The position taken in *Death as*
of Life is just a little to the ri
pity.

Gerald C

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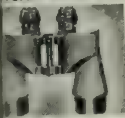

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No 1544E ....$99.50 Ppd.

ICAN-MADE 6x30's

No. 963E ....$65.00 Ppd.

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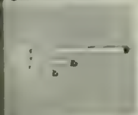

Bring 91% of sun's light indoors NaturEscent lamps give true color fidelity without distortion. Closest thing to natural light—even use outdoor film indoors without filters. Great for indoor gardening. Reduces eye-strain fatigue. Long tube life, fit standard fixtures. Sets of 4.

.151E 15W.. 18"L $14.50 Ppd.
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Sturdy, monocular-type. 3 Coated Achromatic parfocal objectives—5X (0.10 NA) 10X (0.25 NA), 60X (0.85 NA); triple revolving nosepiece. Automatic focusing stop prevents damage to objectives and slides. Fixed 160mm tube. Rack & pinion coarse focusing & fine micrometer type slide adents. 3 Huygenian eyepieces 5X 10X 15X. Baketage 4-1 2" x 4-5 16". 2 stage clips accept Edmund ated mech. stage No. 30,060—Substage equipment: l-condenser lens, iris diaphragm, 1-7 8" diam plano-ve mirror

No 85,049E (11¾" H., 11 lbs. W.) $95.75 FOB

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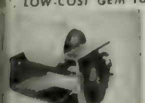

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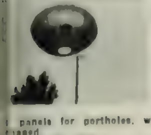

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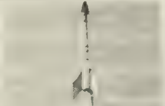

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Puffer Kite	No 41,279E	$2.25 Ppd
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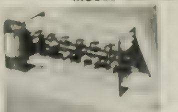

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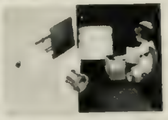

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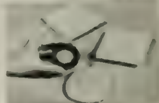

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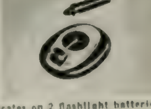

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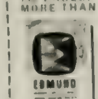

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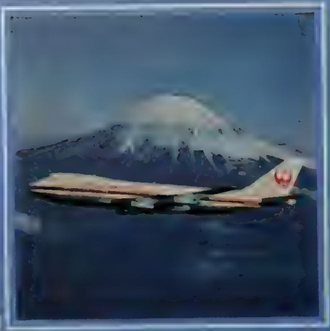

We began, not with our 747 Garden Jets, but with a legend. The legend of the tsuru, a crane native to Japan, whose story is such that parents once told their children to "behave like the tsuru."

For us at Japan Air Lines, the truest motivation is still to "behave like the tsuru." To fly the highest and farthest like the tsuru, yes. But, more, to reflect the care, serenity, and courtesy which the tsuru symbolizes. To bring the legend to life.

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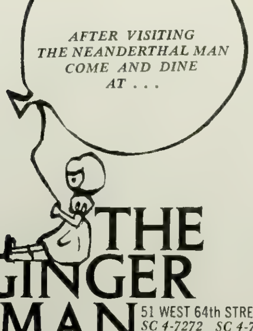

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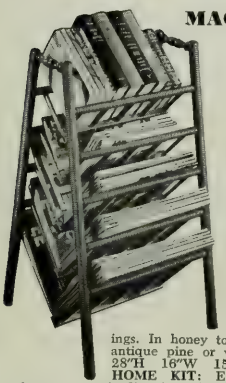

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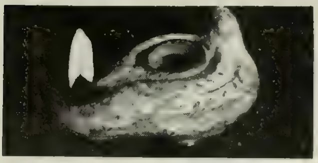

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Suggested Additional Reading

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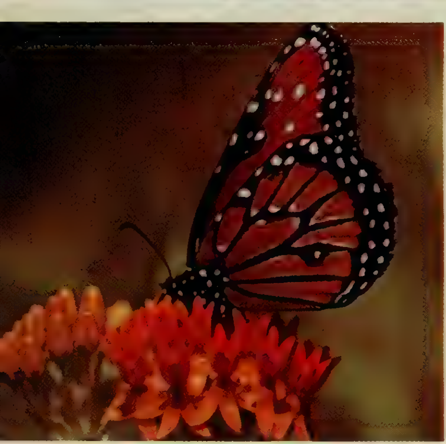

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For macro and extreme close-up photography (of bugs, flowers, stamps or you-name-it), you can use the SR-T 101 and a MC Macro Rokkor 50mm f/3.5 lens. With a bellows, this remarkable lens will give you magnifications up to 5X life-size. It's the world's only macro lens that provides fully automatic diaphragm operation, even at a 1:1 magnification ratio. And it focuses from 9 inches to infinity, which makes it excellent for normal shooting as well as close-ups.

Besides the MC Macro lens, Minolta makes a lot of other macro and close-up equipment. Like an automatic bellows, auto-bellows lens, extension tubes and copy stand. So you can decide how much magnification power you want, and how much you want to spend getting it.

To bring the birds in closer (or anything else), there are eight Rokkor telephotos to choose from. They range from 100mm portrait lenses to a 1000mm super-telephoto.

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An audio engineer talks about the new VM professionals.

Murray Allen owns one of the world's keenest ears. He played sax and clarinet with big name bands like Skitch Henderson's and Bobby Sherwood's before becoming an engineer. And has done sessions for Bobby Melton, The Hi-Lo's, Julie London and many other famous names. Murray was one of the first to experiment in multi-track recording and recently pioneered in the use of 16-track. He is now with Universal Recording Studios where he engineers records and commercials, including the Schlitz and United Air Lines television campaigns which are currently on the air. He was also Audio Consultant to Science Research Associates.

"The VM professionals are really worthy of the name. I've never seen so much professional control in home-type equipment.

"The VM 1521 receiver, for example, does a lot of things even more expensive units I've played with can't.

"The bass and treble controls really give you a lot of room. And it's got a high and low filter you can switch in and out. The separation is terrific, too.

"I mean you can take something like a bass and clarinet duo and completely isolate the bass on one channel, then completely isolate the clarinet on the other.

"Another thing, I live in an area where FM is very RFy. The VM 1521 has a new filter that handles it better than anything I've heard.

"The speakers are something else, too. Good things like air suspension woofer and infinite baffle enclosure. And the variables balanced out with a computer. Really clean sound. Especially the percussions. Even the transients don't get distorted. It even gets those low guitar sounds.

"And I really like the VM 1555 automatic turntable. The cueing. The belt-driven platter. The extra length on the tone arm. The photo-electric tripping mechanism. All of them are terrific.

"And the spindle gently lowers records all the way down to the stopped platter. Really takes good care of them.

"You know how hard it is to reproduce a clean piano or harp. Well, the 1555 does a beautiful job. Absolutely no wow.

"I listened to an album I engineered on a VM professional rig, and I can honestly say it was closer to the master tape than I'd ever heard. I could even hear tape noise which is really rare.

"I've decided to take my VM professional outfit to my office. Every day I deal with people who really know a good sound when they hear it.

"And it always pays to make a good impression."

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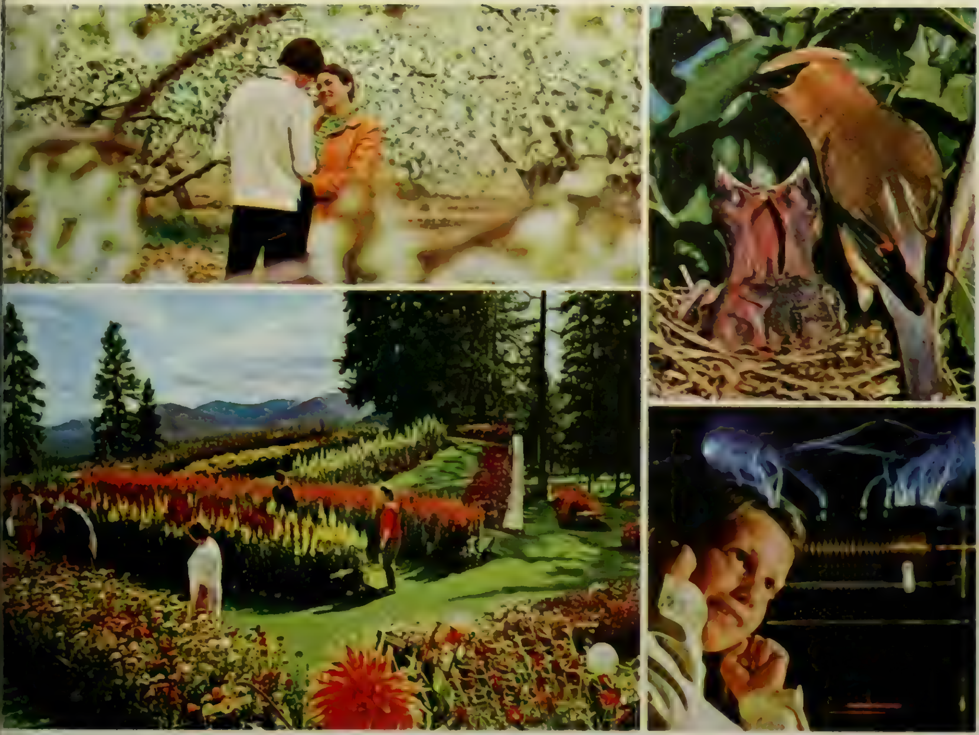

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NATURAL HISTORY

INCORPORATING NATURE MAGAZINE

The Journal of The American Museum of Natural History

Vol. LXXX, No. 5   May 1971

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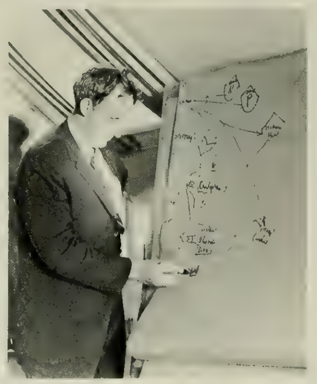
Recognizing the impossibility of enforcing conservation measures against poachers and market-hunters who supply the fashion industry, **F. Wayne King** joined the fight for passage of New York's Mason Act. His testimony outlining the difficulties of identifying animal skins played an important role in the adoption of this law's pioneering ban not only on endangered species but also on those with which they can be confused. King is a member of the Survival Service Commission, Crocodile Specialist Group, of the International Union for the Conservation of Nature and Natural Resources and curator of herpetology and chairman of education programs at the New York Zoological Society. His major research interests are zoogeography, vertebrate paleontology, and the ecology and behavior of reptile populations. On a recent field trip to Borneo, King sought to propitiate the spirits with a chicken.

When **Jack Hope** backpacked in Yosemite National Park last summer, he felt that the park's camping area was like a war zone, filled with hostile vibrations between the long-haired generation and the park's rangers. To find the causes of the trouble, he spent weeks in the park, talking to both sides. Hope, a resident of New York and a former senior editor of NATURAL HISTORY MAGAZINE, is presently a free-lance writer and field editor for *Audubon* magazine. His previous articles for NATURAL HISTORY MAGAZINE include "Prosperity and the National Parks," February, 1968, and "The King Besieged," November, 1968.

In his attempts to measure respiration in a rain forest in Puerto Rico, **Howard T. Odum** has wrapped trees in huge cylindrical bags, sixty feet high. His research in energy flow has covered many types of ecosystems: streams, lakes, coastal waters, river communities, and estuaries. He has studied ecological problems of marine resources and polluted bays, the red tide, and the coral reefs of Eniwetok. He is currently working on energy els and analog simulations of tems of man and nature. A g ate research professor in Department of Environmental neering at the University of ida, Odum received a Ph.D. in ogy from Yale University. Print-out of the Future Systen Man" is adapted from his book, *Environment, Power Society.*



Bruce C. Heezen took son the first photographs of the sea floor in 1947 and has studying and mapping the bot of the oceans ever since. He crisscrossed the Atlantic and cific, the Caribbean, and the terranean. Associate professo geology at the Lamont-Doherty ological Observatory of Colun University, Heezen is coaut with Charles D. Hollister, of *Face of the Deep,* to be publis in June by Oxford Univer Press.

Charles D. Hollister, coaut of "The Deep, Deep Sea Flo likes to set records. In 1966, climbed the seven highest mo tains in Antarctica; now he ho to recover the longest core e taken from the ocean floor. A cl scientist at the Woods Hole Ocea graphic Institution, he has direc coring, seismic profiling, bott ography, and studies of currents umerous cruises. He is presently lved in deep-sea drilling on d a specially equipped vessel, *Glomar Challenger*. He also s to study the effects of bottom ents on sedimentation.

orn in Berlin, **Kay Simmon** to this country as a teen-ager. r completing her B.A. in mathe- es at New York University, became a professional photog-

her, specializing in informal raits of children. Her photo- phic essay, "Manhattan Safari," ns from her observations of real mythic animals depicted on v York City's architectural ms.

The concepts behind The American Museum of Natural History's new Hall of Peoples of the Pacific, which opens this month, began with **Margaret Mead**'s first expedition to that area of the world in 1925. Nurtured by her research over the years, formed and shaped under her close supervision, the hall is another milestone in a career that spans more than forty years of studies, ranging from primitive cultures of the South Pacific to contemporary society in the United States. Mead is curator emeritus of ethnology at the museum, adjunct professor of anthropology at Columbia University, and chairman of social sciences at Fordham University.

Designer of the hall and coeditor with Margaret Mead of the special supplement, "Peoples of the Pacific." **Preston McClanahan** has received national recognition for his work as an artist and as a graphic and exhibition designer. His creations involve the use of a variety of media, with an emphasis on plastics, Plexiglas, and urethane foam. His career as an artist traces back to a portfolio of cow drawings executed in the mountains around his boyhood home in West Virginia. McClanahan studied at the Cincinnati Art Academy and has had shows of environmental sculpture at the Museum of Modern Art and at the Whitney Museum.

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Adventur

the Skin Trade

by F. Wayne King

The furrier
pays the importer
pays the foreign dealer
who pays the poacher
who kills the leopard
whose skin
makes the coat

Writers and filmmakers have con-
tioned Americans to think that a
k into the jungles of Asia is a
ring adventure, with tigers and
pards lurking, ready to spring
m the nearest limb or rock out-
op. But today that is an event
at occurs only in fiction. All the
g cats are now disappearing: the
ers, leopards, cheetahs, jaguars,
ountain lions, and ocelots. Many
her mammals with fine furs and
lorful skins are disappearing as
ll. They are being slaughtered,
inned, tanned, cut, and reas-
mbled into fashion apparel. Some
e now on the verge of extinction,
ought there by the hunters who
pply the skins for the fashion
arket.

It is equally difficult for many of
to envision a trip down an Afri-
n river without picturing croco-
les basking on the river bank or
ithering into the murky water at
e approach of a boat. No jungle
ovie would be complete without
ose crocodiles; the scene featur-
g a river aswarm with them has
come a cliché in stories about Af-
ca. Those same Americans find it
en more difficult to believe that it
a scene missing from many parts
Africa today. The crocodiles are
nishing, victims of hide-hunters'
ns and harpoons and of an igno-
nt public's desire for expensive
oes, purses, belts, and wallets of
ocodilian hide.

What has been happening to the crocodiles of Africa is not unique. Up until this year, virtually every species of crocodilian in the world was being killed faster than it could reproduce.

Most Americans think of the 1800's and early 1900's as the era of the market-hunter. During that period the passenger pigeon was exterminated by hunters who gunned the birds down by the thousands or gassed them with sulfur fires under their rookeries. Millions of the birds were sold in the meat markets of the large eastern cities. Market-hunters also wiped out the heath hen, great auk, and sea mink, while the American bison, sea otter, and fur seal were brought to the edge of extinction before the public became concerned enough to save them. But even with such a grisly track record as a basis for comparison, it is during the last thirty years that market hunting has taken its greatest toll of wildlife. Today, however, most market hunting is done outside the United States, so the effects on wild animals are not immediately visible to the American public.

As the wealthiest country in the world, the United States is the marketplace for a majority of wild animal products. Furs and skins from all parts of the world find their way to New York City's fashion industry. The money paid the professional poacher and hide-hunter comes from the sales of finished animal products and the sales, in turn, finance further slaughter of the wild animals. Eventually, the sales will finance their extinction.

In the fashion apparel field, companies have traditionally been reluctant to regulate themselves in order to save a species; they fear that competitors will make the sales that they deny themselves. The industry has also operated on the principle that rare skins bring high prices; the rarer the species, the more expensive the products made from them. It is this unrelenting pressure from commerce that accounts for much of the decline in the populations of wild animals with valuable hides. So what industry has been slow to do, government is doing through enactment of new legislation.

To counteract the role played by American commerce in the decimation of wild animal populations, Congress passed the Wildlife Preservation Act of 1969. This included the Endangered Species Conservation Act of 1969 and amendments to the Lacey Act. The Endangered Species Conservation Act permits the Secretary of the Interior to promulgate a list of animal species that are in danger of extinction and to prohibit further importation of these creatures or products made from them. If they cannot be imported, they will not be hunted. The Lacey Act, as amended, prohibits the importation of, or interstate traffic in, fish or wildlife or their products obtained illegally in their country of origin. This will aid foreign governments in their fight against poaching and the smuggling of illegal skins.

Such legislation will not prevent the extinction of animals threatened by pollution and habitat destruction. It will not save animals from the cooking pot of a protein-starved hunter and his family. It will only slow the slaughter of commercially valuable species imported for sale on the United States market. This legislation follows in the tradition of the 1913 law that stopped the trade in egret, heron, osprey, and bird-of-paradise plumes. The plumage law was one of the first major pieces of legislation enacted by one country to protect the wildlife of others. The present Endangered Species Conservation Act similarly attempts to prevent excessive commercial exploitation of all mammals, birds, reptiles, amphibians, fish, and mollusks, regardless of country of origin.

The greatest shortcoming of this

legislation are in its administration and enforcement. The Department of the Interior's Endangered Species List contains names of animals in imminent danger of extinction. However, in too many instances the hides, furs, and feathers of these species resemble forms that are not endangered and are therefore not listed. Some of these look-alikes are so similar that they cannot be separated from the endangered species. Although all tigers should be considered endangered, they are not all listed and provide a good example of the problems with this legislation. While Bali, Javan, Sumatran, and Caspian tigers are on the list, the Siberian, Bengal, Chinese, Korean, and Turkestan forms are not. Yet when tiger skins are imported, no mammalogist, let alone government inspector or fur dealer, can tell the hide of one of these subspecies from another. Most tiger subspecies have been described on the bases of skull shape and minor differences in color and hair length. And it is possible to find the total range of variation in one litter of Bengal tigers.

The Nile crocodile has all but been exterminated in eastern and southern Africa and is also on the Endangered Species List. Nevertheless, its importation cannot be prohibited under the federal law, because no one can separate Nile crocodile hides from those of Morelet's crocodile (also endangered), American crocodile, or saltwater crocodile. Descriptions of crocodilian species are based on the shape and placement of skull bones and on the scales at the back of the neck and base of the tail. None of these is available to an inspector looking at commercial hides. As a matter of fact, the similarity of the belly skins of all crocodilians has permitted industry to fool the public into thinking any crocodilian item was "genuine alligator." The phrase *Genuine Alligator* on an item means only that it is made from some crocodilian, not from vinyl or grained calfskin. It is a phrase uniquely American. The American alligator lives only in the United States, nowhere else, so the American public has become accustomed to thinking in terms of alligators every time they see a crocodilian. For example, young caimans are nearly always sold in pet stores as baby alligators. In Europe and tropical Asia, the same items are sold as "genuine crocodile."

Poachers have used this identification confusion to their advantage. Skins poached illegally in one country are frequently smuggled into countries where the species is not protected and the skins can be sold openly. For years feathers of the rare gray jungle-fowl were exported from Nepal even though the species does not occur there. The plumes were smuggled into Nepal from neighboring India where it is legally protected. In the case of widespread species, such as leopards, tigers, and some crocodilians, no one can tell where a particular hide came from originally.

Clearly, if endangered species are going to be protected from commercial hunters, it will be necessary to prohibit not only their importation but also the importation of all species and subspecies with which they can be confused. The Department of the Interior is reluctant to take this step, however. The law does not preclude it from doing so, but the Senate Commerce Committee instructed it not to place a species or subspecies on the list if it is not endangered in all areas of the world. Since some of the animals involved in the identification confusion are not endangered, the Department of the Interior has been slow to add them to the list.

New York State Assemblyman Edwyn E. Mason was aware of what the Endangered Species Conservation Act was designed to do, but he also recognized its weaknesses. As chairman of the state assembly's Committee on Agriculture, he felt that the state might be able to act where the federal government's efforts had run aground. On February 3, 1970, he introduced a bill into the New York Assembly calling for an amendment to the state's agriculture and marketing laws that would prohibit the sale, or possession for sale, of leopard, snow leopard, clouded leopard, tiger, cheetah, vicuña, red wolf, polar bear, mountain lion (puma), jaguar, ocelot, margay, and all alligators, caimans, and crocodiles of the order Crocodylia. Each species was identified by its scientific name so there could be no confusion over which animals were meant. The bill, cosponsored by 44 other semblymen, aimed at total prol tion of all species and subspecie the big cats and crocodilians in der to protect the endangered with which they can be confu Total prohibition also elimin the problem of transshipment skins—poached skins smuggled another country from where t could be shipped legally.

Hearings on this bill and its c panion bill were held in the York Senate on February 20, 1 Debate over the need for the le lation came from industry spol men, conservationists, state and eral wildlife officials, zoologi and indirectly, from representati of several concerned foreign g ernments.

The industry spokesmen m tained that they were true c servationists and felt that the s porters of the bill were misguid They stated that they used only skins of abundant species in th trade. One furrier even claimed t pelts of the rare snow leopard h not been used by the trade for years. To counter these industry guments, conservationists ci newspaper advertisements for le ard, cheetah, and snow leopa coats that had appeared within t last two years.

One industry spokesman argu that while the Nile crocodile w endangered, his company used or "caimans" from Madagascar, a these were not endangered. The fore, he pleaded, he should not prohibited from trading in tho skins. The fact is, however, that c mans are found only in the tropic Americas, and the only crocodili in Madagascar is the Nile crocodil Zoologists long ago developed t use of scientific names to avoi such confusion over commo names.

Representatives of the fur trad worried that the law would caus the death of their industry. This b lief obviously conflicts with the a gument that the industry does n use endangered species. If such an mals are not used, then outlawin their sale could not hurt the indus try.

Some tradesmen claimed that th animals were being hurt by habita destruction, pollution, and the hu man population explosion, but no

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[illegible] Consultant

by the commerce in the whole animals and their products.

The presentation of U.S. Department of Commerce statistics on importations of hides and furs clearly showed that the number of large-cat furs imported account for less than 2 percent of the total number of furs imported each year. From these cats come the prestige furs that draw customers into the stores. Once there, however, they buy mink, fox, and other furs. Mink alone accounts for about 80 percent of total fur sales. Obviously, a loss of 2 percent of sales would not kill the industry. The 2 percent is significant only to the wild populations of the animals concerned. For example, during 1968, the U.S. Department of Commerce reports that 1,283 cheetah skins were imported. Yet field studies in East Africa show that there is an average of one cheetah for every 30 square miles of territory. The 1968 imports were the equivalent of taking every cheetah in an area of 38,000 square miles (*see* "This Gentle & Elegant Cat," NATURAL HISTORY MAGAZINE, June-July, 1970). Little wonder that cheetahs are in trouble.

Conservationists pointed out that funereal forecasts had been similarly voiced by the fur industry when the uncontrolled slaughter of the Alaskan fur seal was stopped shortly after the turn of the century, but the industry did not die. A carefully controlled harvest of fur seals replaced the previous uncontrolled slaughter, and today only a small percentage of the young animals and the bachelor bulls are harvested each year. The remainder, including the breeding adults, are left untouched to produce future young. This sustained-yield harvest assures a constant supply of pelts for the market and does not threaten the continued existence of the species. Yet even with such examples to guide them, the fur industry still prefers uncontrolled exploitation for many valuable animals, even to the point of extinction. In fact, the marketing practices of the trade almost suggest that they prefer rare and endangered species—the rarer the species, the higher the price of the product.

The industry also pointed out that they did not pay the hunters, but only purchased the skins of animals already dead. The Mason bill would not resurrect those animals. While it is certainly true that a ban on sales will not restore life to dead animals, the money from retail sales pays the manufacturer and importer. He in turn pays the foreign dealer, who pays the hunters and poachers. When the whole operation is understood, it is apparent to everyone that the buying public, together with the retail dealer, is supporting the commercial slaughter of wild animals.

The industry questioned the need for protecting all tigers, all leopards, or all crocodilians, when only some species or subspecies are endangered. They asked that the Mason bill be rewritten to include only the endangered forms. Aside from not recognizing the difficulty of distinguishing the skins of endangered forms from nonendangered ones, this points up a lack of insight into the problem of commercially endangered species. Many dealers treat the absence of a particular animal on an endangered species list as license to exploit it. They reason that if it is not endangered, it must be abundant, ignoring the many intermediate states of rare, once abundant but now depleted, and declining in numbers. An animal in any of these categories should not be subject to uncontrolled exploitation.

To counter the zoologists, who supported the ban on sales of all animals that could be confused with endangered species or subspecies, the industry argued that hides could be identified from their shipping points. They claimed that African skins are shipped from Africa or, more specifically, that only Kenya skins come from Kenya and only Indian furs arrive from India. The U.S. Department of Commerce figures disprove this assumption, however. In 1968, cheetah skins were imported from India, but the Indian cheetah has been extinct since 1948. These were African skins transshipped through India. In that same year, transshipped African leopard skins were imported from Argentina, while jaguar skins from tropical America were flown in from the Netherlands, France, Germany, and South Africa. Ocelot skins arrived regularly from England. African slender-snoute crocodiles and South American caimans entered from Thailand Transshipment is so widesprea that importers cannot be sure of th country of origin. This is especiall true where smuggling occurs to obscure the origin of the skins.

At the New York hearings, a letter from Mohamed Awaleh, head o the Wildlife Department of Somalia, was read. Mr. Awaleh described the difficulty of enforcin wildlife protection laws when th profit to be made from smugglin poached skins is great. He said, " personally blame America and Europe for most of this smuggling because it is with your dollars [that you indirectly contribute to th mass slaughter of wild game Smuggling . . . is so great that could not do much in spite o strong new law[s]. . . . I am no appealing to any responsible an conservation-minded American t help us by trying to discourage o forbid importation of such rare species as leopard and cheata [cheetah] from any place in Africa."

Perez Olindo, head of the Keny National Park System, sent a similar letter pleading for passage o the Mason bill. He told how severa of his wardens are killed each yea by poachers and stated that Africa wildlife could not be adequatel protected until the profit was take out of poaching. The only way t do this is to prohibit imports int the United States and Europe. An prior to the hearing in Albany, the wife of the Indian Consul Genera read a statement from Indira Gandhi asking for aid from the citizens of the United States in protecting the big cats and crocodiles of India from further exploitation.

The Mason bill eventually passed the New York legislature and was due to go into effect on September 1, 1970.

In July, 1970, suit was brought in the State Supreme Court of Onondaga County by the A. E. Nettleton Company of Syracuse contesting the constitutionality of the Mason Act and the Harris Act, another piece of endangered species legislation. The Nettleton Company manufactures shoes, some of which are made from crocodilian hides. Nettleton was joined in its suit by four other fur and reptile-hide

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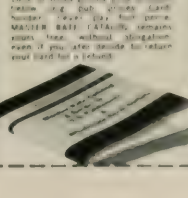

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manufacturers and retailers. their complaints, they questio whether the state had the autho to prohibit the sale of animals on the federal Endangered Spe List. They reasoned that the End gered Species Conservation Act 1969 had pre-empted the field. T also questioned whether the Mas Act, in prohibiting the sale of f eign species, conflicted with the f eral authority to regulate interst and international commerce.

In defense of the law, the N York Attorney General's Office c tended that the state had the thority both to ban the sales of f eign species within the state and base the ban on an endangered s cies list that was at variance w the federal list. The attorney g eral argued that the legislature w correct in considering the consume right to know that the produ he is purchasing are not made fro endangered animals and to prot him from fraud associated wi this.

In its complaint, Nettleton stat that it did not use endanger species in the manufacture of sho Claiming to use only "tinga" a "tinga alligator" hides. to whic the company applied the scientif names *Caiman sclerops* and *C. la rostris,* Nettleton pointed out th neither of these species is on t federal Endangered Species Li According to Nettleton, these hid were imported from western Braz Venezuela, Colombia, Peru, Bolivi and Paraguay. The facts disput Nettleton's claim. Tinga and ting alligator are trade names applied any of the subspecies of commo caiman, *Caiman crocodilus* (*C. scl rops* is an old synonym for this sp cies). The trade names are derive from the Spanish and Portugues common name *jacaretinga.* The sp cies also has numerous other Sout American common names. In th United States it is sometimes calle spectacled caiman when sold as pet, and alligator when sold a leather goods. There are four sub species recognized by zoologists One is found in Central America one in the Apaporis River of Co lombia, one in northern Sout America, and one in central an southern South America. The las subspecies is the jacare caiman, *C. crocodilus yacare.* It is the sub-

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species found in western Brazil, Bolivia, Argentina, and Paraguay, and it is on the federal Endangered Species List. And there is no way to separate this subspecies from any of the other subspecies on the basis of commercial skins alone.

Nettleton's complaint admits that the firm uses hides of *Caiman crocodilus,* and that some of these hides come from western Brazil, Bolivia, and Paraguay. Since the only representative of the species in those countries is *C. crocodilus yacare,* which is on the federal Endangered Species List, how can Nettleton sustain its claim of not using endangered species in its business?

The other species mentioned in the complaint, *Caiman latirostris,* is the broad-snouted caiman of southern South America. Its hide is sold under the common name *overo,* not tinga as claimed by the company. If Nettleton cannot distinguish between hides of the two species, this supports the conservationists' belief that it is difficult to separate species of crocodilians on the basis of commercial hides alone. If Nettleton can separate them, but called the hides tinga, it confused the facts in its complaint.

In August, the lower court ruled that the Mason Act was unconstitutional because it exceeded the state's police powers and deprived the industry of property without due process of law. The court relied heavily on the fact that "the Act does not protect the State's domestic game and wildlife. None of the prohibited Crocodylia is indigenous to New York. In its blanket application, banning all species of crocodiles, the Mason Act is too broad and as such is prohibitive. A persuasive factor in the effect of the Mason Act is its failure to discriminate between the endangered and unendangered species, which is what the federal act does. . . . This type of legislation exceeds the bounds of necessity and is unconstitutionally oppressive."

The attorney general immediately appealed the ruling directly to the State Court of Appeals. Legal precedents were found for states protecting species that were not yet endangered, protecting them "before the danger is unmistakenly imminent," and for states protecting foreign species, as was done under New York's 1909 Bird Plumage Act. It was also pointed out that the federal government has long recognized the states' power to regulate wildlife within its borders whether indigenous or imported. A section of the Lacey Act clearly states that all dead game animals and birds, or their parts, when imported into a state become subject to the laws of the state "to the same extent and in the same manner as though such animals or birds had been produced in such state."

In October the Court of Appeals overturned the lower court by affirming the constitutionality of the Mason Act. In making the ruling the court stated that the law would be unreasonable only if the ban on all sales of the animals listed was unreasonable. Since such a ban was the only way to protect species endangered by commerce, it was not unreasonable. They did "not agree with the industry that the Mason law goes too far." They held that the state was not pre-empted by the federal Endangered Species Conservation Act, and therefore had the power to enact the Mason Act. They further held that the state had not deprived the industry of property without due process. Since the Act banned sales after September 1, the court allowed industry to dispose of animals, hides, and products that arrived before that date.

While all this had been happening in the state courts, Palladio, Inc., a Massachusetts "alligator" shoe manufacturer, had filed suit in federal court to contest the constitutionality of the Mason Act.

The Palladio suit was initiated before the Nettleton ruling had come from the State Court of Appeals, but the Palladio company had agreed to await that ruling. When the state court upheld the Mason Act, Palladio sought to bring its case to the U.S. District Court in Manhattan. Like Nettleton, Palladio argued that the federal legislation pre-empted the field of endangered species law. The Massachusetts company and the industry also questioned whether or not the law was unreasonable, for they maintained that it is possible to distinguish between the hides of endangered and nonendangered species of crocodilians.

Federal District Judge D.J. Mansfield ruled, however, that the ind
try had failed to raise a substan
federal question in its compla
Judge Mansfield, in upholding
Mason Act, stated that:

> It is now generally recogni
> that the destruction or distu
> ance of vital life cycles or of
> balance of a species of wildli
> even though initiated in one p
> of the world, may have profou
> effect upon the health and w
> fare of people in other dista
> parts. We have come to app
> ciate the interdependence of d
> ferent forms of life. We real
> that by killing certain species
> one area we may sound our o
> death knell. . . . Nowhere d
> the Secretary of Interior indica
> that his list of endangered sp
> cies is definitive. The state's l
> of endangered species may
> broader than the federal list si
> ply because the state legislatu
> did not see fit to wait until on
> a handful of species remain
> before it passed a law affordi
> protection. We cannot overru
> the legislature for bei
> cautious.

On March 22, 1971, the Unite
States Supreme Court refused
hear the appeal of the Nettleto
Company, thereby upholding Judg
Mansfield's opinion on state legisl
tive protection of wildlife. Th
United States District Court of A
peals similarly denied the Palladi
Company's suit on March 26.

Since the year 1600, more tha
120 species of animals have becom
extinct. Even though hundred
more are on the verge of extinctio
today, it would seem the America
public is willing to prevent thi
when possible. Since the Mason Ac
was first signed into law, Californi
has passed a similar bill. Californi
did not protect the mountain lion
but they did add the sea otter and
mustang to their list. Florida has
banned the sales of all alligator,
caiman, and crocodile products. The
Massachusetts legislature is debating passage of an endangered species
bill, and others are in preparation
by at least four other states. The
public is not willing to let animal
species die unnoticed, for as noted
by Judge Mansfield, "Extinct animals, like lost time, can never be
brought back. They are gone forever."

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Hassles in the Park

We stopped the car at the park entrance. There was a ranger in the little gatehouse at the left of the road. Two other rangers, wearing revolvers and with long nightsticks fastened to their belts, stood just beyond the shelter, blocking entry to the park.

The ranger in the gatehouse was friendly, and we chatted briefly as I paid the $2.00 entrance fee. The others walked slowly around the car, peering in the windows, looking closely at the tires. They did not smile.

"Over here, when you're through," one said. "Auto inspection." He pointed to two parallel rows of yellow pylons at the side of the road. "Pull the car in there." He walked behind us.

There were four of us in the car. Neil and Yvonne, students at San Jose State College, were in the back seat; Gregory, visiting from England, sat beside me. I had picked up the three riders 60 miles to the east, near the town of Oakdale. They were dressed in dungarees and old shirts, and carried backpacks, a "Yosemite" sign, and a Union Jack tied to a walking stick. The flag helped them get rides, they said. Neil and Yvonne were planning a four day, 30-mile hike from Yosemite Valley to Tuolumne Meadows. They had met Gregory in San Francisco two days before and had invited him to join them on their back country trip.

I pulled the car to the side, between the pylons. Neil was excited. He glanced quickly around at the rangers, then leaned over and spoke to me, hurriedly and quietly. "This whole thing is phony," he said. "They're doing this to all the longhairs. They don't like our looks. They're using the vehicle inspection to keep the freaks out of the park. It's probably illegal, but they do it anyway.

"We went through this the last

by Jack Hope

Antagonisms between rangers and a new generation of campers led to rioting in Yosemite last year. But the two groups may have more in common with each other than either has with the majority of American society

time we were here," he continued. "They found a bad taillight—just one bad light—and wouldn't let us in. We had to go all the way back to Merced to have it fixed."

"But don't worry," Yvonne added. "It's just a hassle. We'll get in. They can't keep us out with this car. It's brand new, isn't it?" she asked me.

The car was new, rented in San Francisco. It was large and shiny, with crisp tires, no scratches, no cracked glass, no broken headlights. The odometer read 4.021 miles. But two of us wore beards, and there were three heads of long hair, including Yvonne's.

The ranger at the rear of the car walked to my window while Yvonne was speaking. He looked back at her. "What's that about a hassle?" he said.

"Nothing," Yvonne said.

The ranger continued looking at her for several seconds. Then he turned to me. "Headlights, please," he said.

I turned on the lights. The ranger in front of the car waved his hand. "All right," he said, "now high beam." The other ranger returned to the rear of the car.

Yvonne leaned over the back of the seat and spoke in a low voice. "When we were here in July, I didn't have any identification. They called my parents in Fresno and asked them if they knew I was in the park with a 'young man.' It was embarrassing."

"Left directional," the ranger in back called out.

"They're afraid of us," Neil said. "They wear guns and they're afraid of us."

"Right directional."

Gregory seemed nervous. He pulled on his beard. "This is extraordinary," he said. "In England, you know, policemen don't wear firearms."

"Brake lights."

"But this is America," Yvonne said. "Didn't you know? We're being invaded by Communists here, by student agitators and effete snobs—all sorts of insurgent groups. They're about to overthrow the country, starting with the national parks."

Gregory laughed. The ranger strode from the rear of the car, bent down to the window, and looked over at him. Gregory was silent and looked straight ahead.

"Let's see your license," the ranger said. I handed it to him and he walked to the front of the car and talked with the other ranger for two or three minutes, still unsmiling. Other drivers pulled up to the gate, paid, and passed through.

"Listen," Yvonne said, "let's tell them our packs are filled with marijuana seeds. Tell them we're going out in the woods to start a pot farm."

The ranger walked back from the front of the car. He tapped my license slowly against his clipboard. "You know, this license expires in 24 days."

"Yes," I said, "I expect to be out of the park by then."

"Any other identification?" I showed him my draft card.

The ranger ahead of the car called out. "Can I see the left directional again?" I flipped the switch, and the light clicked crisply, as before. The ranger bent down and looked underneath the car. I turned off the switch.

"How do you decide which cars to stop for inspection?" I asked.

"Every third car," the ranger replied, handing back my card and license. "All right," he said, "you can go on." He turned and walked away.

We drove from between the pylons, and continued on down the road.

"Every third car?" Neil said angrily. "At least five went through

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while we were there."

"Six," Yvonne said. "Six went by." She turned to Gregory. "Wasn't that fun?" she said. "How did you like it, Gregory?"

Gregory continued looking straight ahead. "Extraordinary," he said. His voice sounded strange. "Truly extraordinary."

It's difficult to say just when or where the confrontation between the Yosemite park staff and long-haired youth first began. Social frictions do not begin with the election of a certain president, the staging of an antiwar demonstration, the appointment of a park administrator, the hurling of an insult or a rock. And they do not occur in a social vacuum.

At Yosemite, the 1970 "security precautions" (or "harassments," depending upon your point of view and, perhaps, upon the length of your hair) were initiated following a riot on July 4.

Among the riot participants, there were 40 park rangers and other park employees, some on horseback, and several hundred young people. The park people had ropes, chemical Mace, nightsticks, and .38 caliber revolvers. The young people had marijuana and pills, rocks and wine bottles. Some were there for confrontation, some for excitement. Some were just there.

Within the framework of the riot there were strong feelings about war and race, authority and materialism. There were stereotyped notions of "establishment," of long-haired youth, and of organized threats to national security. There were memories, either firsthand or vicarious, of former clashes between young people and police at Kent State, Ohio, at Jackson, Mississippi, at People's Park in Berkeley. And there were experiences with local "vigilante" groups that have attacked and beaten long-haired young people in southern and western states. Then, too, there were probably worries about job security; about self-image; there was the usual need to identify an enemy.

For the most part, the July 4 riot took place in 20-acre Stoneman Meadow and nearby campgrounds. The grassy, rectangular meadow lies in the heart of Yosemite Valley, the park's most scenic and m
used area, where 3,000-foot c
rise abruptly on either side of
level valley floor, and where, dur
any normal summer weekend,
ward of 15,000 people congreg
within an area of eight squ
miles. Stoneman Meadow is cros
by a single roadway. It is s
rounded by several large car
grounds, tall stands of incense
dar and ponderosa pine, and by
park concessionaire's Camp Cu
—a complex that includes cabi
dining halls, snack bars, bicy
liveries, offices, a gift shop, a clo
ing store, a barber shop, and
swimming pool.

On July 3, a large group, ma
up mostly of people under 25, ga
ered in the meadow. Some we
drinking wine or smoking ma
juana, some were singing or playi
guitars. Park rangers placed sm
signs in the meadow: "Due to e
treme litter and noise, this meado
will be closed 7:00 P.M." (The no
mal "quiet hour" at Yosemite
10:00 P.M.) The signs, according
some park employees, were fir
posted on the previous day, Thur
day, but were torn down by "hi
pies." Other witnesses claimed th
signs appeared only after the crow
gathered. In any case, the meado
had never been closed in the pas
and the signs and the seven o'cloc
curfew created a challenge. Pre
dictably, the young people did no
respond to the 7:00 P.M. deadline

At seven, rangers with bullhorn
atop their cars repeated the orde
to clear the meadow, telling th
gathering of young people: "You
are a disorderly mob." Then
mounted rangers rode into the
crowd, driving it to the edge of the
meadow. There, rangers on foo
clubbed at least two people to the
ground, witnesses said, handcuffed
them and others, and took them to
the Yosemite jail. Most of the crowd
disbanded and escaped.

The following day, the 4th of July, the damaged curfew signs were replaced and about 500 young people regrouped in Stoneman Meadow. Park administrators hurriedly scouted about for extra manpower. In addition to the regular ranger staff, maintenance men, trail crews, and fire control aides were recruited for the expected confrontation. A large crowd of specta-gathered at the edge of the idow.

)uring the afternoon, a half-en park rangers decided to walk ong the meadow people, asking n—politely, in most cases—to e, discussing the special envi-nental problems of large gath-gs within a national park, offer-to hold a 6:30 mass meeting at earby campground to talk with ng people. But the mold had n cast by events of the previous . Rangers in the meadow were mistreated, but were requested ave. They did.

.t curfew time, the PA systems in requested a clearing of the idow. The young people did not e. They sat in large circles. Hel-ed rangers, and others, gathered ig a wooded fringe of the idow.

'he dozen or so men who could : mounted their animals and rged into the center of the group the meadow. The helmeted men st from cover and rushed into meadow, using nightsticks on young people's heads. The peo-scattered, but regrouped, and ig rocks, fallen tree limbs, and ie bottles, drove their attackers m the meadow. A few of the by-iders, apparently angered by the rge of the horse patrol, sided h the young people.

)ne group of young people threw a log roadblock, preventing ger vehicles from entering the idow area. Policemen from ghboring counties were sum-ned by park administrators. The riposa County sheriff and his uty drove rapidly to the adow, their siren screaming, but v were stopped by the roadblock. :ks smashed their windows. The riff exited, shooting, and was ick with a rock. The deputy did : fire his weapon. The two offi-s retreated, and the meadow peo-exploded some fireworks, then ired to their campgrounds late the evening. The valley quieted.

But in the night, and in the early rning hours of July 5, park ngers, reinforced by the Califor-Highway Patrol, and the sher-s departments of Madera, Fresno, ariposa, and Merced counties, ded the campgrounds surround-g the meadows. Armed with re-

Continued on page 32

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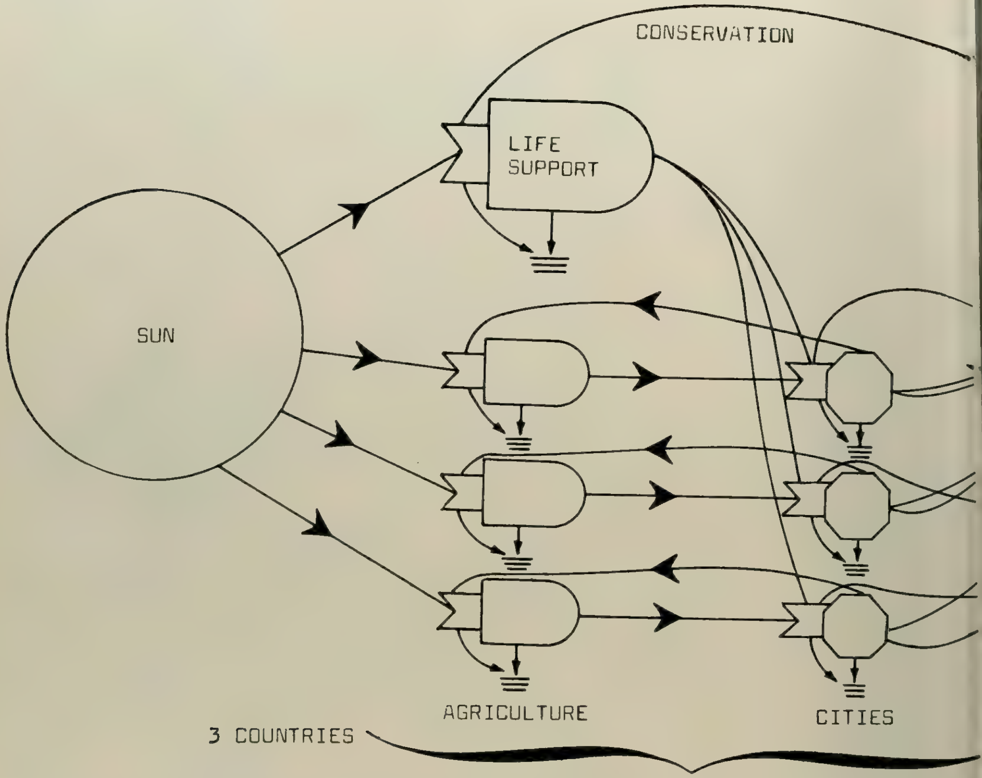

THE FUTURE OF MAN ON EARTH CAN BE DIVIDED INTO ALTERNATIVES ACCORDING TO ENERGY SUPPLIES. THERE IS THE FUTURE OF POWER EXPANDING, THE FUTURE OF POWER CONSTANT, AND THE FUTURE OF POWER RECEDING. NATIONAL AND INTERNATIONAL PLANNING TASK FORCES SHOULD BE ASSIGNED TO EACH OF THE THREE CONTINGENCIES.

WE ARE NOT NOW SURE WHICH FUTURE WILL BE NEXT; PERHAPS EACH WILL FOLLOW THE OTHER IN A STEP-BY-STEP SEQUENCE, FROM THE PRESENT SYSTEM OF EXPANDING POWER, TO CONSTANT POWER, TO RECEDING POWER. THESE ENERGY ALTERNATIVES CONCERN SURVIVAL AND SHOULD PROBABLY DEMAND FAR MORE OF OUR NATIONAL ATTENTION THAN THE STATUS SYMBOL OF SPACE TRAVEL. THE AVAILABILITY OF ENOUGH ENERGY FOR ANY SIGNIFICANT AMOUNT OF SPACE ACTIVITY IS SIMPLY NOT IN SIGHT. THE SPACE PROGRAM MAY INDEED BE A LOVELY FLOWER IN THE LATE SUMMER OF MAN'S CURRENT GROWING SEASON. WE HAVE ENERGY NOW TO PLAN FOR THE FUTURE, BUT LATER THERE MAY BE NO EXCESS CALORIES.

FUTURE OF POWER EXPANDING

AS LONG AS SUSTAINED AND INCREASING SOURCES OF POTENTIAL ENERGY ARE DEVELOPED FROM FOSSIL FUELS AND NUCLEAR POWER, THERE WILL BE ADVANCING PATTERNS OF MORE COMPLEX, SELF-ADJUSTING NETWORKS OF MAN. IF AN AWARE-

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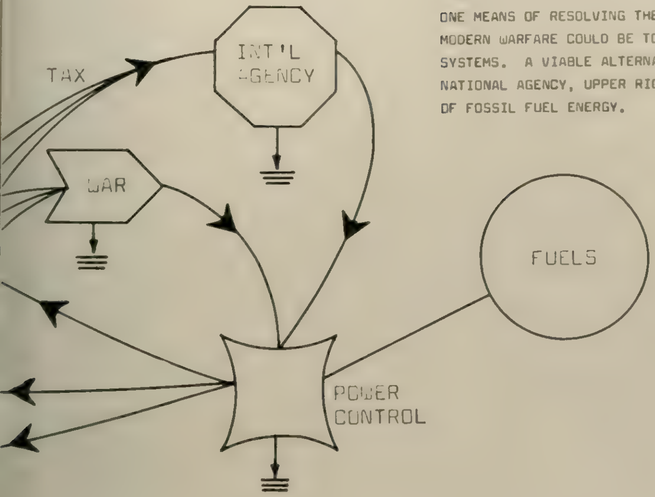
MAN

IN THIS ABSTRACT DIAGRAM, ENERGY FLOWS FROM TWO SOURCES, THE SUN AND FUELS, TO MANY ENERGY SINKS, REPRESENTED BY INVERTED TRIANGLES. THE ENERGIES FLOW THROUGH THE AGRICULTURE AND CITIES OF THREE COMPETING COUNTRIES AND THROUGH THE SURROUNDING LIFE-SUPPORT SYSTEM. WAR IS ONE MEANS OF RESOLVING THE COMPETITION FOR ENERGY, BUT MODERN WARFARE COULD BE TOO DESTRUCTIVE TO ALL LIVING SYSTEMS. A VIABLE ALTERNATIVE WOULD BE FOR AN INTERNATIONAL AGENCY, UPPER RIGHT, TO CONTROL THE ALLOCATION OF FOSSIL FUEL ENERGY.



OF ENERGY LAWS CAN BE BETTER DISPERSED
G THE WORLD'S CITIZENS, SOME IMPROVED DE-
G OF POLITICAL STRUCTURE MAY YET DEVELOP
E-WORLD SYSTEM, BYPASSING MILITARY POWER
ING. HOWEVER, FOR SUCH A ONE-WORLD STRUC-
THE SCIENCE OF ENERGY NETWORKS IN HUMAN
EMS MUST BE URGENTLY ADVANCED. FOR SUR-
WE MAY NEED TO DEVELOP SUCH NATIONAL
ECTS AS A GIANT ANALOG NETWORK MODEL FOR
LATING, IN DETAIL, MAN'S SYSTEM OF ENER-
ND ECONOMICS.

HE INCOMPLETE LOOPING OF MATERIALS IS A
T DANGER. WASTES ACCUMULATE AND MINERALS
FAIL TO REACH ENOUGH AGRICULTURE. IF THE
D DESIGNS DO NOT REGENERATIVELY CONNECT
WASTES TO THE FOOD INPUT, BOTH POLLUTION
STARVATION MAY RESULT AS TWO FACES OF THE SAME DIFFICULTY IN SYSTEMS DESIGN. THERE IS ALSO THE HAZARD THAT SELF-DESIGNING READJUSTMENTS OF SYSTEMS OCCUR ONLY AFTER CHEMICAL LEVELS TOXIC TO THE BIOSPHERE DEVELOP. THIS COULD ELIMINATE MAN LOCALLY AND POSSIBLY EVEN COMPLETELY. FOR THE ENGINEERING OF BETTER REGENERATIVE ECOSYSTEMS CONSISTENT WITH THE NEW INPUTS OF CIVILIZED MAN, AN INTERNATIONAL ECOLOGICAL ENGINEERING PROJECT IS NEEDED THAT, HOPEFULLY, WILL DEVELOP NEW COMBINATIONS OF SPECIES THAT CAN DEAL WITH THE SPECIAL CHEMISTRY INVOLVED.

DURING A FUTURE OF POWER EXPANDING, NEW EDUCATIONAL MEANS WILL BE REQUIRED TO INCORPORATE ALL THE PROBLEMS OF ACCELERATING COMPLEXITY AND TO PROVIDE SENSIBLE ROLES AND PERSPECTIVES FOR EACH CITIZEN. THE SCIENCE OF

GENERAL SYSTEMS MAY HELP TO CONDENSE KNOWLEDGE AND PROVIDE OVERVIEWS. PERHAPS SYSTEMS SCIENCE WILL BE INTRODUCED INTO THE GRAMMAR SCHOOLS, REPLACING THE MISCELLANEOUS MATERIALS OF GENERAL SCIENCE COURSES. MUCH INFORMATION NOW TAUGHT IN DOZENS OF GRADUATE SPECIALTIES INVOLVES DIFFERENT SPECIAL CASES OF THE SAME NETWORK PROPERTIES: THIS INFORMATION COULD BE ORGANIZED IN A UNIFIED CURRICULUM BASED ON SYSTEMS PRINCIPLES, PERHAPS SIMPLIFYING EDUCATION. THE STUDENT MIGHT THEN SEE WHERE HE STANDS IN EXISTENCE. IN THE PROCESS OF REORGANIZING EDUCATION AROUND SYSTEMS PRINCIPLES, A GENERAL SCIENCE MAY DEVELOP TO EXPLAIN THE PHENOMENA OF MAN AND THE ECOSYSTEM. ECOLOGY MAY MOVE CLOSER TO SOCIOLOGY AND THE OTHER SOCIAL SCIENCES.

MANY SPECIALTIES, SUCH AS OCEANOGRAPHY, LIMNOLOGY, FORESTRY, AGRONOMY, AND WILDLIFE AND FISHERIES MANAGEMENT, MAY FORM A COMMON DISCIPLINE, NOT SO FAR REMOVED FROM THE PRESENT SOCIAL SCIENCES. NEW SYSTEMS APPROACHES MAY BE REFLECTED IN NEW CAMPUS DIVISIONAL GROUPS, STREAMLINING EDUCATIONAL CURRICULA AROUND THE SIZE LEVELS OF ORGANIZATIONS THROUGH WHICH ENERGIES FLOW: THE ATOMIC, THE MOLECULAR, THE BIOLOGICAL, AND THE ECOLOGICAL (IN ITS BROADER SENSE). WITH MORE SPECIALTIES, MANY MORE PERMUTATIONS OF LEARNING ARE DESIRABLE AND POSSIBLE. CURRICULA MUST BE LESS RIGID TO ALLOW FOR NEW COMBINATIONS.

THERE IS THE FEARFUL PROSPECT THAT OVERPOPULATION WILL SPREAD FROM ITS UNDERDEVELOPED FOCUSES TO ENCOMPASS THE WORLD INSTEAD OF FALLING BACK BEFORE THE SPREAD OF MORE ENLIGHTENED SYSTEMS. THE DANGERS ARE SOMEWHAT CLARIFIED BY THE ENERGY CONCEPTS. A COUNTRY THAT LIMITS ITS POPULATION IS NOT THREATENED BY ONE THAT OVERPOPULATES AS LONG AS ITS TOTAL POWER BUDGET IS IN EXCESS OF THESE OTHER COUNTRIES, AND IT CHANNELS ITS ENERGIES TO INCLUDE RESERVES AND ADEQUATE DEFENSE. THE COUNTRY THAT DOES NOT LIMIT ITS RATIO OF POPULATION TO ENERGY BUDGET PUTS ITS ENERGIES INTO LOW-LEVEL MAINTENANCE OF IGNORANCE, REGIMENTATION, AND THE MANY MISERIES THAT ARE THE AFTERMATHS OF FOLLOWING SUCH A COURSE.

UNFORTUNATELY, THESE COUNTRIES CAN FOCUS
POWER IN ENDEAVORS SUCH AS MILITARY EXPER
TATION, ALTHOUGH THE POWER FOCUSED CANNOT
CEED THAT POSSIBLE FROM COUNTRIES WITH GRI
ER ENERGY BUDGETS. AN IMPORTANT UNSOLVED
QUESTION FOR SIMULATION IS THE NATURE OF
WORLD SYSTEM THAT WOULD BE IMPOSED ON ITS
BERS BY A WORLD GOVERNMENT ENCOMPASSING C
TRIES WITH TWO ENERGY SYSTEMS, THE ONE DE
CATED TO A MAXIMUM POPULATION-TO-ENERGY-B
RATIO, THE OTHER TO A MINIMUM POPULATION-
ENERGY-BUDGET RATIO

NO SINGLE COUNTRY CAN COMPLETELY LIMIT
OWN POWER EXPENDITURES BEFORE OTHER COUNT
DO BECAUSE THE POWER EXPANSIONS GIVE INDU
AL EDGES, WHICH WOULD FORCE THE POWER-LIM
COUNTRIES INTO ECONOMIC DEPRESSION. THUS
TERNATIONAL POWER CONTROL RATIONING MAY BE
QUIRED IF THE ENERGY SUPPLIES DO NOT BECO
LIMITING SOON. UNLIMITED, EXPLOSIVE POWER
PANSION ON THE PRESENT ACCELERATING SCALE
THREATEN THE PLANET'S LIFE-SUPPORT SYSTEM
THE PRESENT POWER BUDGET OF MAN, NOW AT 10
PERCENT, BECOMES A LARGE PROPORTION OF THE
PLANET'S ORGANIC ECOLOGICAL ENERGY BUDGET.
THE TOTAL MEASURE OF MAN'S DESTRUCTIVE ACT
IS IN PROPORTION TO HIS TOTAL INDUSTRIAL P
BUDGET.

THE GREATEST NEED OF ALL, NOW LARGELY U
REALIZED IN A WORLD THAT TALKS OF POPULATI
EXPLOSION AND ECONOMIC RUNAWAY, IS TO GAIN
CONTROL OF THE BASIC CAUSE, WHICH IS THE A
CELERATING OUTFLOW OF POTENTIAL ENERGY FRO
THE FOSSIL-FUEL SUPPLIES. IN SOME WAY THE
TROL OF THIS FLOW MUST BE PLACED IN THE PU
SECTOR, FOR THE PUBLIC GOOD, AND THE FLOW
BILIZED. THERE MUST BE INTERNATIONAL AGREE
TO PREVENT COUNTRIES BENT ON COMPETITIVE EX
PONENTIAL GROWTH FROM MAKING RUNAWAY EFFORT
THAT SEEM TEMPORARILY GOOD FOR THEM, BUT TH
ARE CANCEROUS FOR ALL IN THE LONG RUN.

UNLIMITED CONTINUOUS GROWTH OF THE URBAN AND INDUSTRIAL SECTORS IS ALREADY BEGINNING TO STRESS AND DIMINISH THE VERY LARGE LIFE-SUPPORT SERVICES OF THE SEAS AND FORESTS, SUCH AS ABSORBING WASTES. TECHNOLOGY THEN TRIES TO PROVIDE THOSE SERVICES AT MUCH

ER COSTS. TAXES AND COSTS GO UP AND
CONOMY BECOMES UNCOMPETITIVE FOR LACK
TURE'S FORMERLY FREE SUPPORT. A DILUTE
RE OF TOWNS AND NATURE IS THE FORMULA
WINS OUT IN THE LONG RUN, BECAUSE TECH-
Y IS NOT AN EFFICIENT SUBSTITUTE FOR
IFULLY MINIATURIZED SYSTEMS OF LIFE
RT.

TIONING WORLD FUEL IS A FEARSOME TASK
MOST OF THE FUEL SUPPLIES IN THE HANDS
ALL, PARTLY DEVELOPED COUNTRIES AND
COMPANIES, BOTH OF WHICH OPERATE UNDER
T-RANGE PLANNING ONLY. WE HAVE A CHANCE
E CAN FIRST EXPLAIN TO THE CITIZENS OF
WORLD THE UNDERLYING ENERGY CAUSES OF
SITUATION. THEN THE ENERGY REFORMS OF
RNATIONAL LAW CAN FOLLOW. THIS WILL RE-
E INCORPORATION OF THE ENERGY ETHIC
ALL RELIGIOUS PROGRAMS.

F OUR STRUCTURE OF ECONOMISTS ADVISING
PLANNING ENDEAVORS WILL INCORPORATE THE
C ENERGY DRIVES IN ENERGY-ECONOMETRIC
LS, THEN WE MAY SUBSTITUTE MORE CERTAIN-
OR THE HERETOFORE ELUSIVE ABILITY TO
ICT ECONOMIC DETAILS USING AN INCOMPLETE
L. THE RISING LEVELS OF EDUCATION AND
WORLD TELEVISION COMMUNICATION MAY MAKE
THIS POSSIBLE.

F IT IS CORRECT THAT USE OF POTENTIAL
GY TENDS TO DEVELOP EQUAL DISTRIBUTIONS
NETWORK, GRADUAL EQUALIZATIONS MAY CUT
THE FORCES THRUST ACROSS NETWORK JUNC-
S BETWEEN POOR AND RICH AREAS. THE STA-
ITY OF DOMINANT PROTECTORS MAY BE REPLACED
OME STABILITY OF INSTITUTIONAL UNIFICA-
IN ORDER TO FOCUS ENOUGH POWER FOR WORLD
ANIZATION.

THE ENERGIES OF WAR ARE THE OLD WAY, AP-
ENTLY WORKABLE IN PRIMITIVE LOW-ENERGY
TES, OF ADJUSTING INFLUENCE GEOGRAPHICAL-
BUT THESE SYSTEMS WHEN ENERGIZED BECOME
IMPOSSIBLE HIGH-ENERGY WARS OF OUR RE-
T HISTORY. THERE IS SURELY ENOUGH ENERGY
ERTIBLE FROM THESE FLOWS TO DEVELOP THE
TER POWER CONTROL MECHANISMS.

* * * * *

FUTURE OF POWER CONSTANT

PERHAPS THE MAN-CONTROLLED ENERGY EXPLOSION IS NOT LONG FOR THIS WORLD. THE CURVE OF EXPONENTIALLY RISING ENERGY USE MAY BE CROSSING THE CURVE OF INCREASING COSTS OF FINDING CHEAP NEW ENERGY SOURCES. THE ACTIVITIES INVOLVING ENERGY EXCESSES MAY DISAPPEAR; THEN THE AMOUNT OF STRUCTURE AND USEFUL FUNCTION THAT CAN BE SUPPORTED WILL STOP INCREASING. THERE MAY BE A LONG PERIOD OF LEVELING ENERGY BUDGETS OF A FAIRLY HIGH PLANE, BUT THE EXPANDING ECONOMY MAY BE GONE. THE CITIZEN WILL SENSE THIS PROCESS AS INFLATION. AS IN THE SMALLER NATURAL ECOLOGICAL SYSTEMS WHEN THEY CHANGE FROM SUCCESSIONAL EXPANSION TO STEADY STATE CLIMAX, THE PREMIUM SHIFTS FROM THE FAST GROWING DEVELOPERS TO THOSE THAT DO THE MOST WITH THE LEAST. GROUP-SERVING SPECIALISTS AND DIVERSITY REPLACE COMPETITION, SURGES, AND EXPANSIONS.

A STABILIZATION OF CHANGE MIGHT ALLOW THE CODIFICATION OF YET UNFOUND RELIGIOUS FAITHS THAT WOULD CHARACTERIZE THE NEW NETWORKS. POSSIBLY NEW PROPHETS WILL EMERGE FOR RELIGIOUS ADAPTATIONS TO THE COMPLEX MODERN SYSTEMS. AN ADAPTED RELIGION MAY CAUSE GREAT ENERGY ECONOMIES IN THE SWITCHING SYSTEMS THAT DEDICATE PEOPLE TO GROUP CAUSES ULTIMATELY FAVORABLE TO THEMSELVES.

STABILITY ALLOWS COMPLEX DIVERSITY AND UNIQUENESS OF INDIVIDUALS. AS IN AUGUSTINIAN ROME, THERE MAY BE GOLDEN ERAS - IF MEN CAN BE SATISFIED WITH SMALL CAUSES, FOR ENERGIES BIG ENOUGH FOR NEW CAUSES WOULD HAVE TO BE DIVERTED FROM OLDER ENDEAVORS. THIS IN TURN REQUIRES A WILLINGNESS TO DISCARD ACTIVITIES.

A DECLINE IN EXPANSION MAY ALLOW MANY ASPECTS OF EVOLUTION TO CATCH UP IN SELF-DESIGN PROCESSES. THE REGENERATIVE SYSTEM OF NATURE MAY EVOLVE THE ECOSYSTEMS FOR DEALING WITH MAN'S WASTE AND RECIRCULATING THE MATERIALS BACK INTO AGRICULTURE. THE AIR AND WATER MAY AGAIN BE CLEAR.

WITH LEVELING OF ENERGIES, THE HAZARDS OF ENERGY SHORTAGE BEGIN TO DEVELOP IN HIDDEN WAYS. DEVELOPMENT OF MORE NETWORK STRUCTURE AND NEW PROGRAMS REQUIRING MAINTENANCE MAY USE THE ENERGY RESERVES. THEN, IF FLUCTUATIONS AND DEMANDS FOR POWER DELIVERY ARE FORCED UPON THE SYSTEM, AND IF CONTROLS ARE NOT SPECIFICALLY DESIGNED TO PREVENT IT, ENERGIES MAY BE DIVERTED FROM THE ORGANIZATIONAL INSTITUTIONS RATHER THAN FROM INDIVIDUALS. ONCE ORGANIZATION FALTERS, THE COMPONENTS MAY SEPARATE WITH NO ENERGY FOCUS AVAILABLE TO REUNITE THEM. UNDER THIS KIND OF STRESS, SAFETY MAY REQUIRE A RELIGIOUS SWITCHING SYSTEM IN INDIVIDUALS, CAPABLE OF MAKING THEM PUT THE SYSTEM FIRST, SINCE THE ULTIMATE SAFETY OF THE INDIVIDUAL IS IN A STABLE SYSTEM. HIGHLY INDIVIDUALISTIC PRIORITIES AND LOYALTIES MAY BE DANGEROUS IN COMPLEX STATES THAT HAVE NO ENERGY EXESSS.

* * * * * * * * * * * * * * * * * * *

FUTURE OF POWER RECEDING

THE FOSSIL RECORD IS FULL OF SYSTEMS THAT ROSE, THEN FELL TO EXTINCTION. BIOLOGICAL SPECIALIZATION IN ORGANIC BODY DEVELOPMENT TENDS TO BE ONE-WAY, WHILE NEW DEVELOPMENTS TEND TO COME FROM THE UNDIFFERENTIATED, UNSPECIALIZED CELLS THAT ARE TUCKED AWAY AMIDST THE POWERFUL MAIN STRUCTURES OF ACTION, SUCH AS MUSCLES AND NERVES. IN ANALOGY WITH THESE FACTS, MANY AUTHORS AFTER HEGEL HAVE SUGGESTED THE DANGERS OF EXTINCTION OF THE MAIN CIVILIZATION THAT MIGHT FOLLOW ANY EFFORT TO DECREASE ITS ACTIVITY. CAN COMPLEX CIVILIZATION DEDIFFERENTIATE? ARE GENERALIZED PARTS SUCH AS THE YOUTH A MEANS FOR PROGRAMMING CHANGE? CERTAINLY IT IS AN IMPORTANT CONTINGENCY TO CONSIDER THE POSSIBLE FUTURE OF CIVILIZATION IF, AND AS, THE ENERGY BUDGETS RECEDE TOWARD THE LEVEL OF ENERGY AVAILABLE FROM SOLAR INCOME.

WE MAY ELIMINATE FEAR OF INEVITABLE DISINTEGRATION AND EXTINCTION BY POINTING TO THE ORDERLY RISE AND FALL OF MANY ECOSYSTEMS I RHYTHM WITH THE RISE AND FALL OF THE SEASO AL ENERGY BUDGETS. SYSTEMS SUCH AS CERTAIN TEMPERATE FORESTS AND THE NORTH ATLANTIC E TUARIES EXPERIENCE A TENFOLD OR GREATER CHANGE IN THEIR ENERGY FLOWS EACH YEAR WIT OUT DESTRUCTION. THESE SYSTEMS HAVE MECHAN FOR REDUCING THEIR DRAINS, DIMINISHING THE POPULATIONS, DISPERSING CONCENTRATIONS, AR ING MIGRATIONS, AND MAINTAINING THEIR GENE ORDER IN A MORE DILUTE FORM CONSISTENT WIT THE DIMINISHED ENERGY BUDGET. FOR ANY NATI AL TASK FORCE ASSIGNED THE RESPONSIBILITY PREPARING FOR THE CONTINGENCY OF DECLINING POWER, THE CHALLENGE CONSISTS OF DEVELOPIN SUCH A TRANSITION PLAN FOR MAN. THE PATTER NEED NOT BE SUDDEN COLLAPSE, ALTHOUGH PREC DENT EXISTS FOR BOTH GRADUAL AND CATASTROP IC ADJUSTMENT.

WHILE ENERGIES ARE STILL IN EXCESS, ADEQUATE PREPARATIONS CAN BE MADE FOR PRESERV AND HOLDING THE NEEDED KNOWLEDGE AND CULTU MEMORY IN LIBRARIES AND INSTITUTIONS. THEN PLANS CAN BE MADE FOR MORE AGRARIAN SYSTEM BENEFITED BY THE KNOWLEDGE WE NOW HAVE ABO THEM. WE CAN PLAN FOR SMALLER CITIES, FEWE CARS, GREATER RATIOS OF AGRICULTURAL WORKE TO TOWN CONSUMERS, AND FEWER POLLUTION PRO LEMS.

POPULATION CAN BE DRASTICALLY CUT BACK A ANY TIME BY CRASH BIRTH CONTROL EFFORTS IN PROPORTION TO THE EXPECTED ENERGY BUDGET; SUCH A CUTBACK MAY POSSIBLY BE ESSENTIAL TO PREVENT COLLAPSE. IN THIS ADJUSTMENT MAN WI BE FOLLOWING THE THOUSANDS OF PRECEDENTS IN LONG-SURVIVING ANIMAL POPULATIONS.

THERE WILL BE A FINE HERITAGE OF INSTITUTIONS AND CUSTOMS THAT COST RELATIVELY LITT TO KEEP IN DILUTED FUNCTION, EVEN THOUGH THEIR OVERLY SPACIOUS BUILDINGS MAY HAVE TO RECEIVE A LOWER LEVEL OF MAINTENANCE. THE LESSER ERA MAY HOLD A BETTER ORGANIZATION THAN EUROPE'S MIDDLE AGES DID IN RELATION T ROME. AS LONG AS THE ENERGY RATIO TO THE INDIVIDUAL IS HIGH, THE STANDARD OF LIVING NE NOT BE LOW, AND THE AIR AND WATERS WILL BE BEAUTIFUL AGAIN. IF THE RECESSION IS CARRIE

SLOWLY, WITH THE CRITICAL ASPECTS CON-
LLED BY PLAN, THE WORLD MIGHT WELL BE BET-
R OFF AND LIFE QUITE LIVABLE. THE FIELD
T IS NOW CALLED HISTORY WILL THRIVE IN A
RENAISSANCE, PROVIDING GUIDING PLANS, AS
RLY FORGOTTEN MECHANISMS OF LOWER-ENERGY
CIETIES ARE RETURNED TO FUNCTION AFTER CEN-
RIES OF DISUSE AND RELEGATION TO MUSEUMS
REMOTE CULTURAL BYWAYS.

A BRIGHT POSSIBILITY IS ECOLOGICAL ENGI-
ERING. ADEQUATE KNOWLEDGE ABOUT THE NATURAL
LAR-ENERGY-BASED SYSTEM MAY ALLOW A SMALL
NCENTRATED LOOPBACK OF ENERGY TO GUIDE THE
STEMS OF FIELDS, FORESTS, AND SEAS TO STA-
LIZE AND PRODUCE FOR MAN (SEE FIG. 1).
ILE THERE IS YET EXCESS ENERGY, IT MIGHT
BETTER TO PUT CRASH EFFORTS INTO ECOLOGI-
ENGINEERING RATHER THAN INTO SPACE. A
OWLEDGE OF NATURAL SYSTEM CONTROL WILL BE
VASTLY GREATER SURVIVAL VALUE TO MAN THAN
MEMORY OF SPACE EXPLORATION. ONLY A SMALL
RCENTAGE OF ENERGIES TAKEN FROM NATURAL
STEMS NEED BE PUT BACK AT THEIR UPSTREAM
TE CONTROL CIRCUITS TO DIRECT THEM TOWARD
E UNIT CHOSEN TO RECEIVE THE YIELD.

WE DO NOT KNOW WHAT ROLE DIVERSITY SHOULD
KE IN THE STABILITY OF SYSTEMS WHERE YIELDS
E NEEDED. PERHAPS A SWEDISH PATTERN WILL
EVAIL IN WHICH THERE IS A DIVERSITY OF
ELD SYSTEMS IN SMALL ALTERNATING PATCHES,
CH ONE BEING UNIFORM. FOR EXAMPLE, THERE
E SPRUCE PLANTINGS FOR PAPER, INTENSIFIED
RICULTURAL PONDS, AND URBAN ZONES. SOME
TURAL MARINE SEA BOTTOMS ALSO HAVE DIVER-
TY IN PLOTS, EACH OF WHICH IS UNIFORM
THIN.

THE SOCIAL SYSTEM MUST ALSO BE PREPARED.
W-ENERGY STATES WILL MAKE WAR LESS TER-
BLE THAN NOW, AND IF KNOWLEDGE OF THE
YS TO ORGANIZE AGAINST COMPETITIVE EXCLU-
ON TENDENCIES CAN BE DEVELOPED WHILE WE
ILL HAVE EXCESS ENERGY, WARS MAY BE ELIM-
ATED. AS WITH ECOLOGICAL PLANNING THERE
THE SAME NEED TO USE AVAILABLE EXCESS
ERGIES TO PLAN FOR FUTURE SYSTEM CONTROL
A LOW-ENERGY NETWORK OF MAN. LOOPBACK
CUS OF RELATIVELY SMALL ENERGIES MAY BE
ABLE TO HOLD WORLD ORGANIZATION. IF RELIGIOUS SYSTEMS CAN DEVELOP A NETWORK-FAVORING ETHIC AS A SWITCHING SYSTEM TO HOLD INDIVIDUALS IN SUPPORT OF WORLD ORDER, THE MANIFOLD ORGANIZATION SET UP AT HIGH-ENERGY LEVELS MAY BE MAINTAINED AT LATER LOW-ENERGY LEVELS. GREATER WORK EXPENDITURE IS REQUIRED TO CREATE NOVEL STRUCTURE THAN TO MAINTAIN IT. THE PREPARATIONS NEED TO BE MADE NOW FOR THE CONTINGENCY OF RECEDING POWER.

* * *

THE NEW PROPHECY

THESE THREE CONTINGENCIES MUST PRACTICE THE SAME ENERGY ECONOMY IN ADAPTING INDIVIDUALS TO THE NEW IDEALS BASED ON NEW SYSTEMS OF MAN. WHILE THERE IS ENERGY, WE NEED TO STIMULATE RELIGIOUS EVOLUTION.

WE MAY ENCOURAGE FASTER RELIGIOUS CHANGE EVEN NOW BY INJECTING LARGE DOSES OF SYSTEMS SCIENCE INTO THE TRAINING OF RELIGIOUS LEADERS. WHAT A GLORIOUS FLOOD OF NEW REVELATION OF TRUTH GOD (THE ESSENCE OF NETWORK) HAS HANDED MAN IN THE TWENTIETH CENTURY THROUGH SCIENCES AND OTHER CREATIVE ENDEAVORS. HOW FALSE ARE THE PROPHETS WHO REFUSE EVEN TO READ ABOUT THEM AND INTERPRET THE MESSAGE TO THE FLOCK. WHY DO SOME INHABITANTS OF CHURCH PULPITS FIGHT THE NEW REVELATIONS SIMPLY BECAUSE THE TEMPORARY PROPHETS ARE A MILLION SPIRITUALLY HUMBLE LITTLE PEOPLE IN LABORATORIES AND LIBRARIES, ONLY VAGUELY AWARE OF THEIR ROLE? WHY NOT OPEN THE CHURCH DOORS TO THE NEW RELIGION AND USE THE PREADAPTED CATHEDRALS AND BEST ETHICS OF THE OLD TO INCLUDE THE NEW? LET US INJECT SYSTEMS SCIENCE IN OVERDOSES INTO THE SEMINARIES AND SEE WHAT HAPPENS. WHY SHOULD WE FEAR THAT DEVIATION FROM THE RIGID SYMBOLS OF THE OLD RELIGION IS DEVIATION FROM MORALITY? A NEW AND MORE POWERFUL MORALITY MAY EMERGE THROUGH THE DEDICATION OF THE MILLIONS OF MEN WHO HAVE FAITH IN THE NEW NETWORKS AND ENDEAVOR ZEALOUSLY FOR THEM. PROPHET, WHERE ART THOU?

The Deep, Deep Sea Floor

Flash cameras lowered to the bottom of the sea reveal bustling activity in a frigid, eternally dark world

by Bruce C. Heezen and Charles D. Hollister

Beneath the sunlit pelagic gardens of an ocean's surface lies a vast abyss, a lonely, dark underworld sparingly populated by strange beasts. The abyssal floor, lying beneath two miles or more of salt water, makes up more than half of our planet's surface. Yet until recently its scenery—virgin and unseen—existed only in the imagination. Some of those who carefully examined the material brought up by dredges and trawls had constructed a fairly accurate view in their mind's eye, but until the invention of the deep-sea camera 25 years ago, no one was completely certain what the sea floor really looked like.

Today we can view the abyss with less mystery and more understanding. A vast, unremitting snowfall of sediment has cast a veil, sometimes a thick blanket, over the rugged, grand, imposing ribs of the solid earth that forms the foundation of the sea. This oozy bed has become the frugal home of creatures adapted to conditions of life so precarious that before they were discovered, it was widely believed that none would be found.

In this seasonless world of total and eternal night, "scenery" acquires a special meaning. Mountains, plains, valleys, and canyons of the deep sea are neither smaller nor less impressive than those on land, but we simply cannot see them with our own eyes, nor can they be seen by the sea's inhabitants. One cannot photograph a seamount in the same way one can photograph Mount McKinley or the Matterhorn on a clear day. Even with the most powerful lights, the restrictions imposed by the murkiness of sea water allow one to see only a few square yards at a glance. Therefore, a full view of the larger features must be inferred from echo soundings and this view is, of necessity, abstract.

On the smaller scale, which can be photographed, pictures reveal evidence of life far more frequently than life itself. The universal, dominant, and in the majority of cases, the only features seen in deep-sea photographs are mounds, depressions, and irregularities that appear to have been produced by animal life. Biological sampling has repeatedly shown the existence of benthic organisms in the abyss, but cann even suggest how or to what degr they affect the landscape of the s floor. The camera can.

The creatures of the abyss are the end of a long food chain th reaches from the sunlit surfa down to the lightless, skin-deep ba terial pastures on the endless refu heap of the deep-sea floor. Camer can search through this vast, blac frigid, and watery Hades for tho few sparks of life that have som how found a way to survive witho light at temperatures never high than 35 degrees. Easiest to find a the visual effects that the vario animals may have on the sea floo The lowly sessile forms, which a attached to the bottom and depen on currents to carry in food an carry away their waste, contribu little save their own decorativ shapes, but the more advanced, m bile beasts, particularly the large ones, produce through their act vities most of what can be seen o more than half of the planet. Th animals living on the abyssal floo are rarely even as large as a robi and only a few are as large as mouse. In fact, most deep-sea crea

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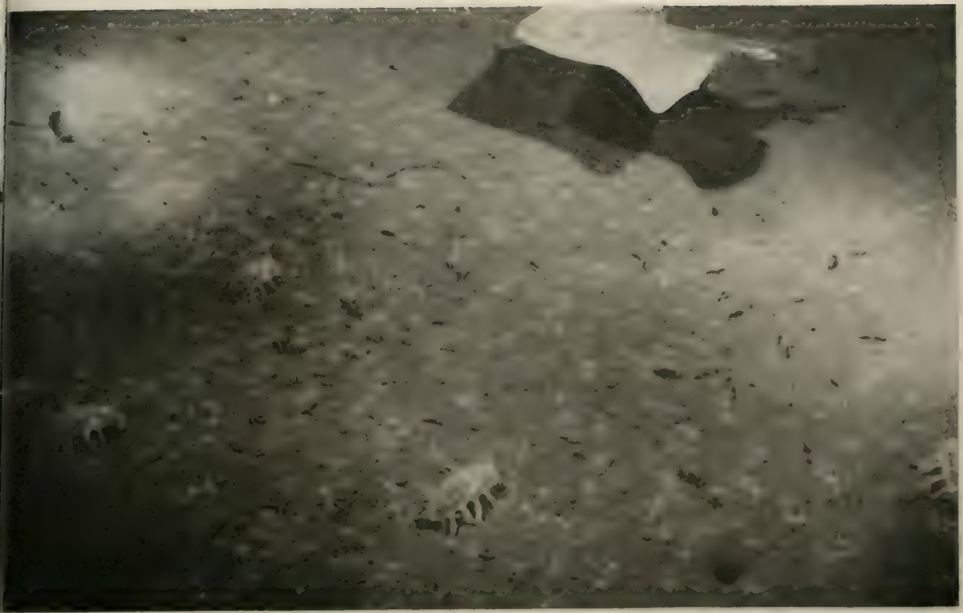


Off the California coast, at a depth of some 3,600 feet, sea cucumbers march over a sea floor littered with brittle stars. A ray swims by.

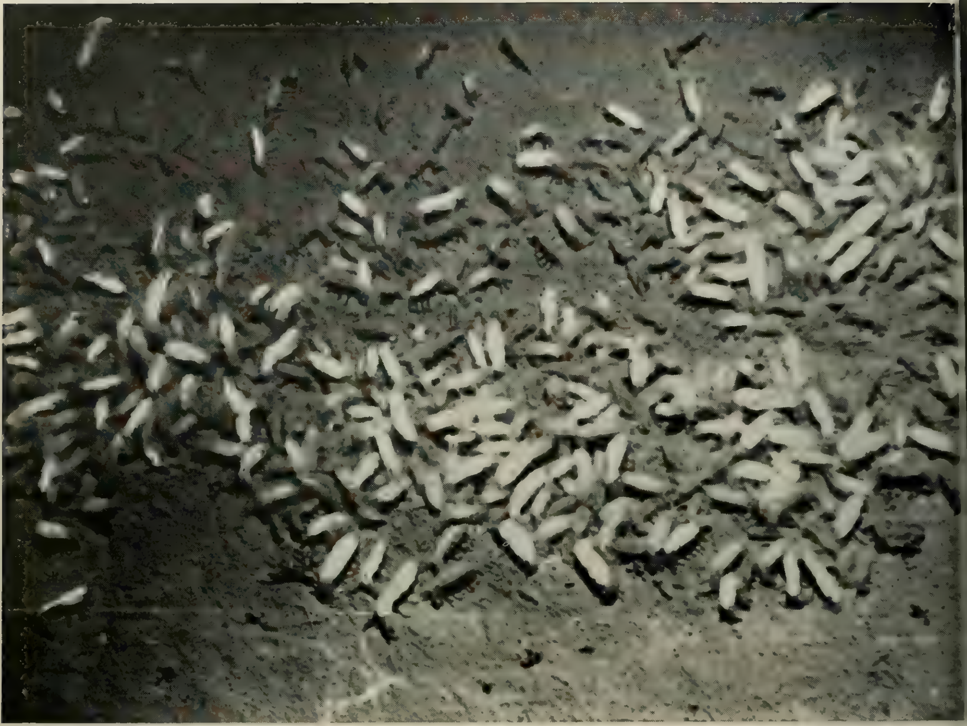
s are smaller than honeybees
are therefore far too small to
seen in standard deep-sea-floor
ographs. For example, clams,
ms, and crustaceans are common
s brought up in trawls with
hes finer than 1/100 inch, but
a few of these are large enough
e seen in photographs.

lthough the abyssal fauna is not
damentally different from that
other cold-water regions of the
it does possess a few peculia-
s that are apparently related to
on a dark, calm mud bottom.
atures of the abyss tend to be
formly colored in shades of gray
black. Many are delicately
t. Some possess long, slender
, and the sessile animals often
e relatively long stalks to raise
n above the mud. Many crusta-
ns and fish are blind, and some
the latter have developed espe-
ly long, tactile fins. Another
uliarity of abyssal life is that
increasing depth the number
animals deriving their nour-
ment from the ooze, or filtering
rom the water, increases as the
nber of scavengers and carni-
es decreases. Also the density of
life is extremely low. Whereas 11 pounds of living organisms can be found on a square yard of inshore sea floor and half a pound might be recovered from a square yard of the continental shelf, in the mid-ocean abyss the amount drops to about two-millionths of a pound per square yard, and the seascape appears stark and barren.

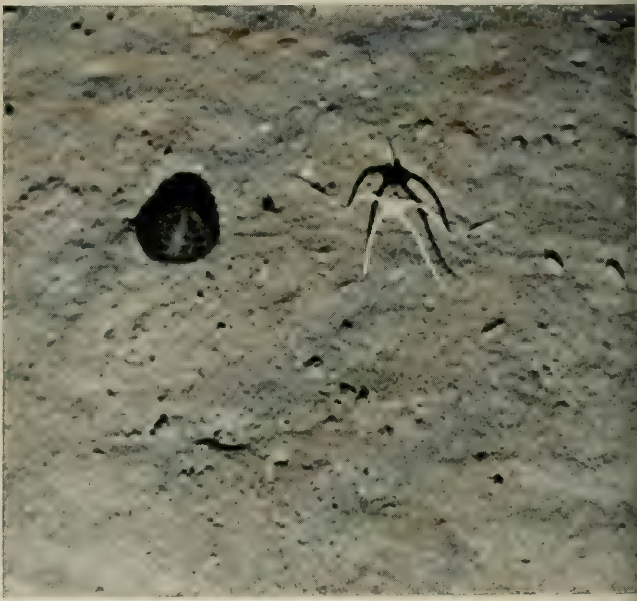
Sea cucumbers (holothurians) are the largest and most numerous animals seen on the deep-sea floor. Reaching a foot and a half in length, they occur abundantly in all depths. Those that graze on the ooze and clay, tracking the bottom and remolding the sediment, create prominent and characteristic features that, over wide areas, dominate the abyssal landscape.

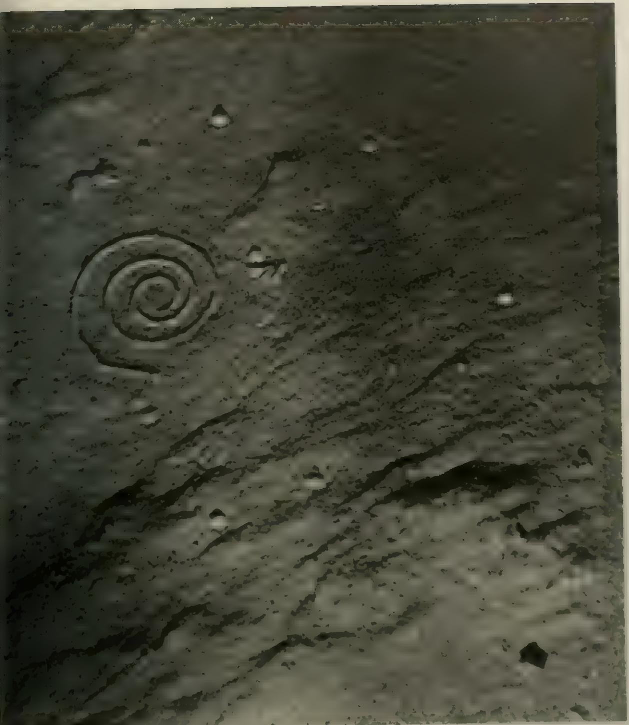
The ocean covers 73 percent of the earth's surface and more than 80 percent of this is a soft, sediment-covered sea floor. This is the home of the abyssal holothurians, the most evident organisms seen in abyssal photographs. And the combination of these circumstances leads one to the inescapable conclusion that holothurians are the dominant large animals of the major part of the earth's surface. Holothurians feeding on bottom sediments mix and till the surface muds on an enormous scale, producing features more widespread and more visibly evident than those produced by any other animal on earth.

The pictures on these pages were chosen to impart some idea of life on the ocean floor. It must be stressed, however, that it is not the living organisms themselves but their effect on the sediment during the course of their lives that is the principal thing to be seen on most of the deep-sea floor. Footprints, plow marks, excrement, holes, and mounds compose nearly all there is to see in the vast majority of abyssal photographs.

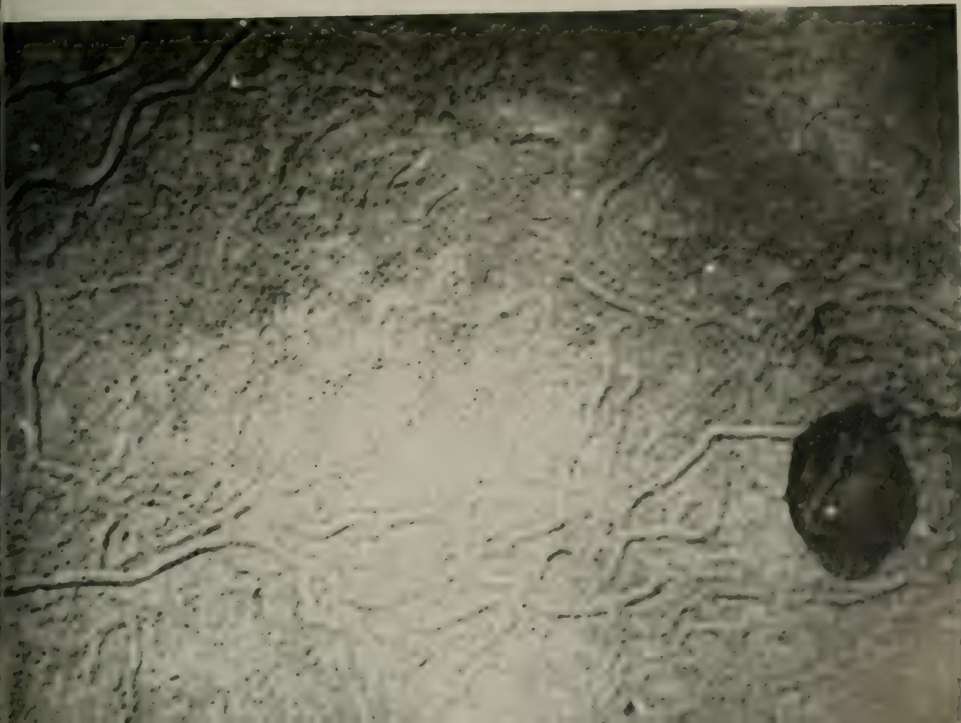


In a remarkable picture taken a mile down east of Cape Hatteras, sea cucumbers, above, swarm together on the bottom. At right, a brittle star arches over the track of a sea urchin in 13,600 feet of water near the Antarctic Peninsula.





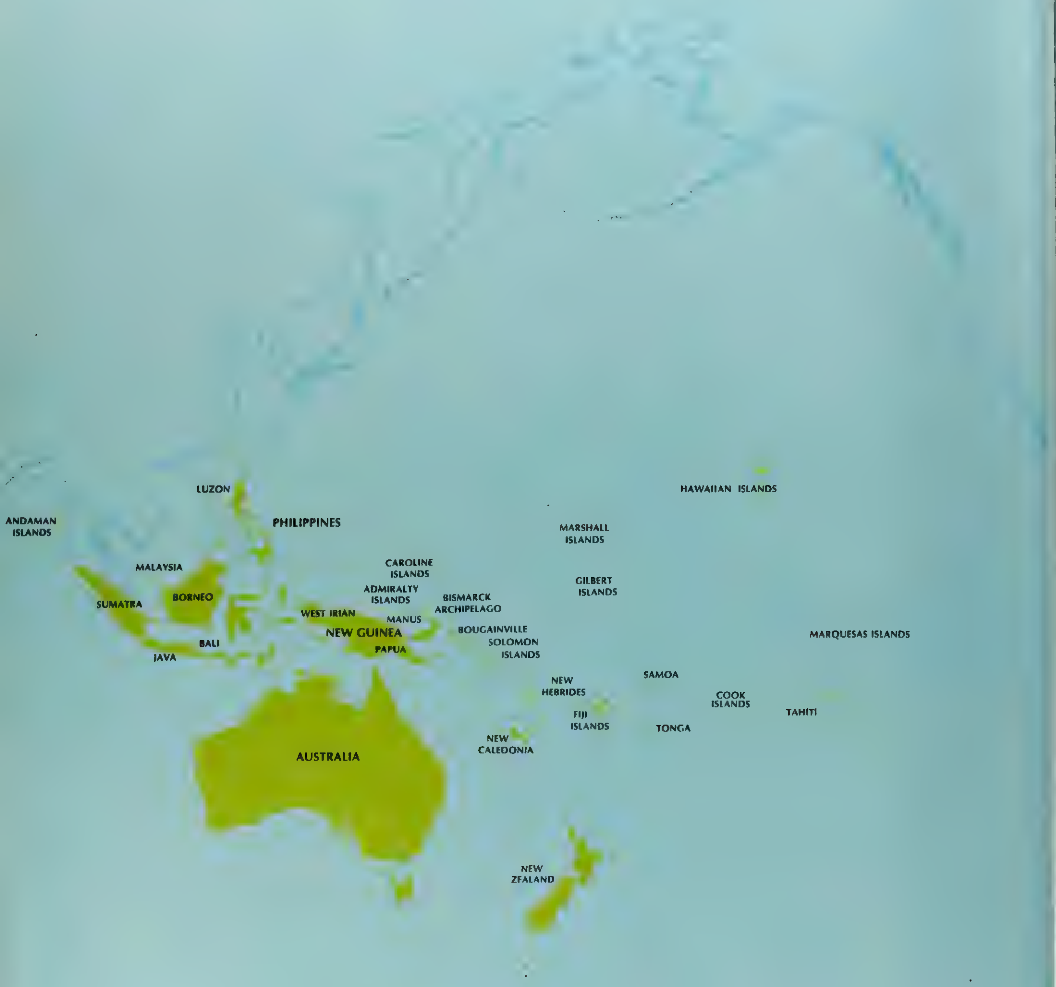
A fecal coil, left, indicates the presence of life 21,700 feet down near the Marshall Islands. More than five miles down in the New Britain Trench, a coconut husk, below, lies on well-tracked sediment.



PEOPLES OF THE PACIFIC

Edited by Margaret Mead
and Preston McClanahan

From tiny islands of human li
in a vast, watery doma
come the elements that form
the Hall of Peoples of the Paci


LUZON
ANDAMAN ISLANDS
PHILIPPINES
HAWAIIAN ISLANDS
MARSHALL ISLANDS
MALAYSIA
CAROLINE ISLANDS
GILBERT ISLANDS
ADMIRALTY ISLANDS
SUMATRA
BORNEO
BISMARCK ARCHIPELAGO
WEST IRIAN
MANUS
NEW GUINEA
BOUGAINVILLE
MARQUESAS ISLANDS
BALI
PAPUA
SOLOMON ISLANDS
JAVA
NEW HEBRIDES
SAMOA
COOK ISLANDS
TAHITI
FIJI ISLANDS
TONGA
NEW CALEDONIA
AUSTRALIA
NEW ZEALAND

he Hall of Peoples of the Pacific
ses, for the benefit of future gen-
ions, the material records of the
ishing cultures of the Pacific Is-
ds and Australia as the people
nselves enter the modern world.
se are island cultures, reflecting
their special characteristics the
ment of isolation from one an-
er, as well as from the world at
ge. Islands only a few hundred
es apart may be centuries apart in
hnological development.

slands are fragile and vulnerable
earthquakes, typhoons, hurri-
nes, and volcanic eruptions. Al-
ugh the Pacific Ocean covers al-
st a third of the earth's surface,
some 25,000 islands total only
out 1,000,000 square miles. The
tlement of the Pacific has taken
ce over thousands of years as
d masses have risen and fallen
d land bridges have been estab-
ned and broken.

The people range in physical type
m the massive, tall, wavy-haired
lynesians, to the slender, lithe
alay people; from the pygmies of
Philippines to the black Solo-
on Islanders. On large islands, like
w Guinea and Borneo, conditions
ore typical of continents are found,
th widespread diffusion of culture
its. The continent of Australia,
wever, has some of the character-
ics of an island because it was iso-
ted for so many centuries.

Diversity of culture, language, and
ysical type makes the Pacific area
ne of continuing interest. Today
ese peoples struggle to assimilate
d make their own way, engulfed
the spreading technologies and
eologies of the modern world. Yet
ey also continue to reflect some of
eir distinctive ways of life, some of
hich have been cultivated for
ousands of years, while others
rang up only yesterday with the
oming of new tools or were newly
laborated after a landfall on a fara-
ay island. For some of these we
ave full records, for others only
leverly crafted featherwork or
inely beaten bark whose makers
erished a century ago.

Bali, Indonesia

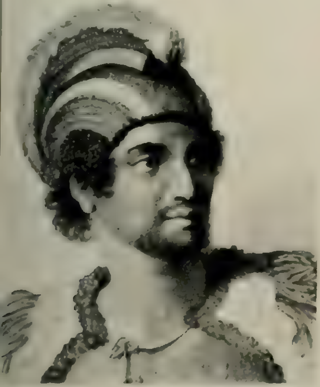
The Pacific area contains a wide v
of environments for man, from the
of the sea at Manus, Admiralty Is
left, to the lush highlands of Huli t
men in New Guinea, below, t
bleak, rugged outback of Aus
right, where Aborigines eke out a
hood.

Samoa.

OLYNESIA

Polynesians, "people of the many islands," was the name given by seventeenth-century European navigators to the tall, golden-skinned peoples whom they found on every habitable island from Hawaii in the north to New Zealand in the south and Easter Island in the east. These islanders caught the imagination of the early explorers, who were fascinated by the combination of their relative technical simplicity and social sophistication, their pride, and the harmony of their relationships to the sea. Polynesian groups were remarkably similar, racially and culturally, although many of them had been separated so long that they did not know of each others' existence. Yet many spoke mutually intelligible languages, shared the same myths and the same type of social organization, and worshiped the same gods. Myth attributed their origins to an emergence through a long series of births from paired personifications of natural forces or to long evolutionary sequences.

Polynesian origins have been a subject of continuous controversy. Earlier theories of their voyages from the Asian mainland or from the Americas have been replaced by the current feeling that they must have developed some 2,000 years ago, perhaps from many sources in eastern Melanesia, and were subsequently dispersed. Earlier ethnologists believed that there were once regular voyages between Tahiti and Hawaii. Today, scholars believe such voyages were beyond their skill and that the islands were populated as a result of landfalls by peoples who had not planned to travel so far, and when they did so, lacked the navigational skill to make return trips. The evidence from linguistic analyses, from archeological finds, and from blood groups is still fragmentary, and almost every year new results and new theories emerge, which propose answers to the problems of how a people, homogeneous in so many respects, could have emerged and maintained their culture over such distances and so many centuries.



ch Hawaiian men greeted European plorers. From Cook's third voyage, 76-1779.

waiian canoe, sketched by Louis horis, nineteenth century.

Adaptations necessary for life on small atolls and on high volcanic islands resulted in some differentiation, but throughout, chieftainships were based on validated genealogical claims and relationships to sacred places of the ancestral gods. The basis of their social organization was descent groups, through which access to rank and power was given in both male and female lines. Their type of political organization responded flexibly to differences in land and population sizes, and their mythology was finely attuned to nature, to the gods of the earth and the sky, to the beginnings of man's sensate experience in the cosmos. Gods and men, objects, and descent groups were ranked and had *mana*, supernatural efficacy, in different degrees. A system of *tapu*—from which the English word *taboo* derives—governed the respect demanded for them. Polynesian religion was based upon a belief in an ordered universe, which if violated, brought disaster; if observed, brought prosperity.

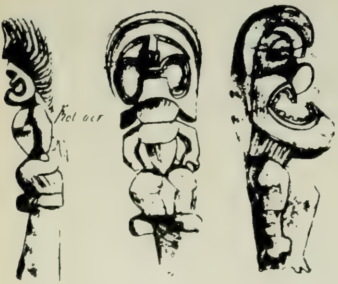
They were an aristocratic people. On some islands everyone shared to some degree in the great genealogically specified past, but on larger islands, territorial political power overrode such kinship, and ruling castes developed from which commoners were excluded. The warfare and conquest that supported these political systems reached its height after

European discovery, when European weapons and European ideas monarchy—more political and less religious than those of tradition Polynesia—supported the last ambitious Polynesian conquerors. Whi stone was used in the construction of platforms and Polynesians ha tools of polished stone, their technology was primarily based on woo with a tremendous dependence on the coconut palm. Pottery is found i very early archeological sites, but it was later abandoned in favor wooden bowls, gourds, and earth-oven cooking. Cordage was made o of coconut fiber, and material for clothing was made from the beate bark of the paper mulberry. Yams, taro, and sweet potatoes were grow with no more elaborate tools than a digging stick. Clubs, spears, and axe were used in warfare. When Polynesians reached the colder islands New Zealand, they invented a new method of weaving from native fla and as in almost everything they manufactured, standards of workmanship were high. Pride was the principal psychological sanction, an children were reared to respect their ancestry, walk with dignity, an work with skill. Men of the highest rank were proud of their technic ability and knowledge of genealogies. Elaborate ceremonies were conducted on behalf of the whole community. Rituals of language and deportment were highly developed, and infractions were prevented both b supernatural sanctions for breaking the *tapu* of a chief or a sacred plac and by secular sanctions of force.

Tattooed Maori man, New Zealand.

People of every race have found the Polynesians beautiful in all respects, a judgment that seems to have resulted from the Polynesians' lon periods of isolation during which they encountered no other people t disparage or to be disparaged by. They met Europeans as equals on th battlefield, in sport, and in the interchange between leaders. They had n strong intoxicants and drank for ceremonial and convivial purposes a astringent drink called kava, made from the root of a pepper plant. I competitions, it was honor that was sought, and the victors feasted th vanquished. However, crowding and the scarcity of resources led to th development on some islands of systems of social exploitation wit slavery and human sacrifice.

The great homogeneity of the culture of these peoples, separated from each other for hundreds of years, may be attributed to the cultural emphasis on earlier homelands and the determination to preserve their past All variation had to be interpreted as variation on a decreed pattern and this conservatism was greatly elaborated. Each island culture, recognizably Polynesian, had its special extravagances: the stone statues, monotonously repetitious, of the Easter Islanders; the clubs and paddles of the Cooks and Australs, carved beyond the possibility of use; the feathe capes of the Hawaiians, woven from two wing feathers plucked from a single bird, which was then released; the Samoan elaboration of the kava ceremonial. These are all examples of varied cultural traits stemming from a conservatism that had trammeled the imagination and permitted it narrow yet explosive expression.



Carvings of gods, Hawaii.

The Polynesians, although robust physical types, were highly susceptible to disease. Historically they were not found on islands where there was malaria, and the diseases brought by Europeans wrought havoc among them. They responded actively to European culture, and early contact was marked by intermarriage and the adoption of Christianity. But they preserved their proud sense of identity through all of these changes and today they are working—in Samoa, New Zealand, Hawaii, Tahiti, Tonga, and the Cook Islands—toward new definitions of their cultural inheritance. It is as a people in tune with their island habitats that the Polynesians continue to meet and delight modern travelers, insatiable for other life-styles that seem more natural than their own.

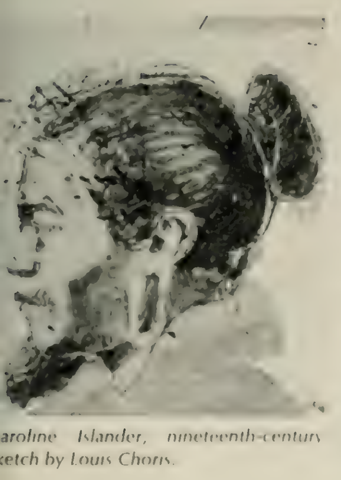
MICRONESIA

Micronesians, the "people of the small islands," inhabit an area larger than the United States, but the entire land surface of the estimated 2,500 islands is only 1,260 square miles. A brown-skinned people, they are both physically and linguistically much more diversified than the Polynesians, although they resemble them in their emphasis on rank and chieftainship. Status defined by well-established lineages was the basis of their political system, but it lacked the flexibility of the Polynesian descent system since descent was often rigidly fixed by matrilineal emphasis. Leadership was vested in membership in high-ranking lineages. Land was owned collectively by descent groups or, as in the cases of unused land or unlimited reefs or lagoons, by districts. Scattered homesteads or small hamlets were the rule. In most parts of Micronesia there was a strong contrast between the amount of sexual freedom before and after marriage, and individuals were sometimes in their twenties before mature responsibilities were assumed and stable and enduring marriages finally established. The immediate surroundings held a host of nature spirits and legendary deities, but greater reliance was placed upon shamanistic activities, divination, and magic. Sacred places were rare, and there was little development of a priesthood.

Micronesian navigation was highly developed, and trips between the small, hurricane-swept atolls and the higher islands safe from complete devastation were common. Even longer voyages to obtain rare and precious objects were undertaken. The Micronesians had an unusual and specialized knowledge of winds, currents, and stars, and made charts out of strips of coconut leaf midrib to assist them in their voyaging.

The inhabitants of the high islands—Saipan, Truk, Ponape, Guam, and some large islands like Yap—had fertile land and ample resources for farming and fishing. Those who lived on the low islands, the tiny windswept atolls, depended more on fishing and on pandanus and coconuts. Complementary relationships between resource and local manufacture contributed to a type of cultural diversification different from that of Polynesia. The Micronesians journeyed far in search of dyes, phosphates, and special manufactures. For instance, Yap Islanders sailed to Palau to quarry the stone for their great disks of stone money. The low islanders produced mats, sennit (coconut fiber cord), coconut oil, textiles, toddy, and shell ornaments, which they traded for turmeric, basalt rocks for earth-oven cookery, timber, giant taro, and preserved breadfruit. Groups of islands were bound together under the loose overlordship of high chiefs, who exacted tribute and provided refuge in time of storm and famine to the less fortunate atoll dwellers. This overlordship was also extended by periodic warfare, especially in the Marshalls and Gilberts where a special type of sennit armor was made. The manufactures of Micronesia are notable for fine workmanship in textiles, in fishing gear, and in the building of canoes. Throughout, the emphasis is more on standards of manufacture rather than on design or decoration.

Perhaps more than in any area of the Pacific, the vicissitudes of storm, drought, overpopulation, and underpopulation, combined with the different resources of markedly different physical environments, are responsible for the cultural differences among the Micronesian peoples. While they have responded to the innovations brought in by Spanish, German, Japanese, and American colonial regimes, they have also displayed a capacity to preserve and adapt their corporate political structures and their attitudes toward collective activities, even in cases where the population has shrunk twentyfold, as on Yap. In addition to the interest aroused by mid-twentieth-century administration of island populations, this part of the Pacific is also politically important because it is one of the areas of the earth's surface that may be crucial for expanded space travel.



aroline Islander, nineteenth-century ketch by Louis Choris.

MELANESIA

Melanesians, or "black islanders," was the name given to the peopl of New Guinea and the surrounding islands, eastward as far as Fiji a north to the islands of the Bismarck Archipelago. For many thousands years, dark-skinned peoples with tightly crisped hair, belonging to ancient Melanesian population complex, have been drifting into the ar from their original homes in Asia and Indonesia. There have also be more recent backflows from Micronesia and Polynesia. Nowhere el today do we find such diversity of culture, language, and physical typ or people so recently exposed to the civilizations of East and West. Ne Guinea itself has a population of about two million people speaki more than 500 different languages, and the rest of the area only numbe another two million.

The most outstanding characteristics of the area, about which no ge eralizations are completely valid, include the rarity of forms of politic authority extending beyond very small units of clan, ward, or village a the dependence upon achieved status by men who become "Big Me through mobilization of food for extensive feasts. On New Guinea a the larger islands there is a general division between the gardeners a sago workers of the interior and the fishing peoples of the coasts a small offshore islands, a tendency to village specialization, extensive ce monial trading relationships that provide pathways for the trading necessities, frequent markets for food, and various kinds of compulsi barter in which goods are obtained by particular forms of exchange.

Very little archeological exploration has yet been done, and it will be long time before physiological studies of blood types and much neede linguistic data present even the beginning of a coherent picture of ho these islands were settled. Thus the course of migrations to the larg islands and the subsequent settlement of their interiors is not clear known. It is believed that the first settlers may have been hunters a gatherers and that some food crops, such as the sweet potato, may be South American origin. Pigs and fowl were introduced later. There extraordinary diversity of terrain: grassland, coral and volcanic island low-lying swamps, inland lakes, and cool, high mountain ranges.

Manus canoe, Admiralty Islands.

While the Polynesians conservatively attempted to maintain the hi toric tradition on each of their far-flung islands, the Melanesian people including those of New Guinea, emphasize every form of diversit whether of linguistic practice, physical size, minor custom, or speci food habit, as a basis for further differentiation among themselves. The incessant interest in ceremonial exchange and barter, whether it involve great trading rings, like the Kula of the Massim area, or the exchange nearly identical shell rings among the mountain Arapesh of New Guine is expressed in the continuous, purposeful export and import of every so of object: magic charms, dance steps, and even forms of marriage. Pi form the basis of feasting and wealth almost everywhere, except wher turtles and large sea mammals are sometimes available.

Where Polynesia presents a homogeneity of culture, race, and lan guage, in Melanesia all such correspondences are lacking. In Bougain ville, in the Solomons, the native population of 50,000 people speak nine different Papuan languages (a term used for non-Melanesian lan guages) and seven different Austronesian languages. The Papuan speaker live inland, the Austronesian speakers near the coast and in the norther interior. In height, Melanesians range from very tall to near pygmy size and all of them are dark skinned.

The archipelago known as the Admiralty Islands, a single large islan ringed by small ones, is a miniature of the whole New Guinea area. Her the people of the interior, the Usiai, practice only gardening, while th

Manus of the south coast engage only in fishing and trading. On some of the small islands, gardening, fishing, and use of canoes are combined. Throughout the archipelago there is great specialization in the manufacture of bowls, beds, spears, daggers, baskets, canoes, in the production of food products, and in local ownership of fishing rights and fishing methods. Genealogies of some groups have time depth, others only two or three generations. Some twenty languages, all related, are spoken, and new dialects are being recognized and developed into languages today. Raiding for prostitutes and for land was frequent. In the past, villages composed of patrilineal clans split frequently, and the whole population, on land as well as in the lagoons, had a pattern of fluid change of residence, regrouping about Big Men, fission, and flight. A principal basis for cooperation was kinship, with an emphasis on the relationships between the children of brother and sister and on the elaboration of the rights of those who had married out of the clan. Networks of trade friends, often hereditary and based on a kinship model, provided sanctuaries for individuals traveling abroad.

Religiously, the Melanesians were equally diverse, and magic and sorcery were highly developed. Mediums and ancestor worship occurred, but in the traditional religious forms there was minimal emphasis upon personal religious experience. The division between men and women, a recurrent theme in all of Oceania, was particularly strong and extended not only to the initiatory practices and the division of goods presented by the relatives of the bride and those of the groom, but also provided much of the dynamics for the fertility of crops and the protection of fishing.

boy proudly pretends to write.

Early writers on Polynesia were preoccupied with the question of origins, but later, more scientifically trained field workers in Melanesia tended to concentrate on the dynamics of living cultures, treating each small language group as a whole. More recent research is emphasizing the wider networks that cross linguistic and cultural barriers and are dominated by the exchange and trading patterns. Some centralization of political power has emerged since European contact, resulting from the concentration of wealth in the hands of the Big Men, whose influence was formerly more limited by continuous headhunting and warfare.

Furthermore, the wars and treaties among various metropolitan powers—Britain, Imperial Germany, Australia, the Netherlands, and Indonesia—have resulted in the creation of artificial boundaries and discrete styles of culture contact as groups of people have become accustomed to the law, currency, language, and governing style of various colonial powers. Some of the Solomon Islands lie within the Territory of Papua New Guinea and some in the British Solomon Island Protectorate. The New Guinea mainland was once divided three ways between Germany, Australia, and the Netherlands, but is now divided between West Irian, governed by Indonesia, and the Territory of Papua New Guinea, governed by Australia. The government of the New Hebrides is shared between Britain and France. Fiji became independent in 1970.

It is only since World War II that serious expectations of nationhood have developed, along with educational institutions designed to fit Melanesians for participation in the modern world. Because of the lack of large-scale indigenous political units, the development of a capacity for self-rule depends heavily upon forging links between leaders, those who would have been Big Men in the past, as they study together at the new universities and medical schools or serve in the police and in the armed forces. Radio broadcasting and the development of a common language, Neo-Melanesian, in Papua New Guinea have helped to develop a sense of community among these extraordinarily diverse peoples.

NEW GUIN

The islands of Melanesia show many traits that link them with Polynesia and Micronesia on the east and north and with Indonesia on the west, making it difficult to generalize about the area in any way. But the island of New Guinea, ringed by the rest of Melanesia and tied in some ways to the continent of Australia, presents many distinctive features. Continuous trading of ceremonies and customs, as well as of shell and bone valuables and local products such as feathers, dyes, and stone, has produced a bewildering recurrence of the same cultural themes. Men's houses, initiation rites, sacred noise-making instruments, headdresses and wigs, and masks worn in spectacles performed for the benefit of women and uninitiated combine in hundreds of different ways as they are traded, elaborated, and discarded, only to be reimported later.

The Sepik River is particularly rich in artistic productions used as the basis for theatrical performances. Most of these involve the attachment of a great number of temporary objects—flowers, leaves, feathers—to a more permanent core of carvings, the masks, wands, and bustles that are rehabilitated for each ceremony. The Asmat people in their swamp habitat have produced a distinctive art that has unique features, like the treatment of the praying mantis as a theme, but it is also reminiscent of the way in which canoe prows are decorated hundreds of miles away.

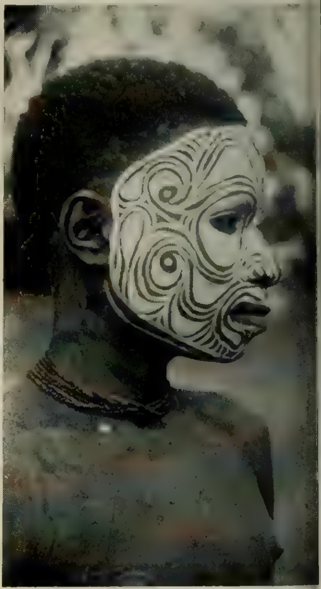
In the interior highlands of New Guinea, unexplored until the 1930's and even until after World War II in many areas, there are much larger language groups that have every appearance of having undergone a population explosion resulting from the successful cultivation of the sweet potato. Here there are much more extensive feasting patterns, with climactic pig feasts in which great numbers of pigs are slaughtered. And there are also many anomalies. Stone mortars and pestles and occasional odd stone figures are found among people who have no idea of either their use or history.

Although some of these interior peoples have been cut off from the sea for centuries, marine objects have been widely traded. Because of such trade there are no peoples who do not have some knowledge and contact with other adjacent peoples. Recent research has concentrated on patterns of warfare, which sometimes serve as a spacing device to drive conquered peoples into less crowded areas. Sometimes, as among the Dane, two warring groups will be trapped in an endless feud. The strongest contrast between the highlands and coastal New Guinea is in population density. In the Upper Chimbu Valley, population density reached 600 persons per square mile. Every activity, gardening, pig feasts, or battles, is on a larger scale. Significantly, the peoples of the highlands lack the genealogical base, ancestor worship, and ritual attachment to land that are found so often in the coastal areas.

Culture contact has permitted the formation of wider alliances, although in some cases it has intensified the savagery of warfare between groups. But it is also significant that nowhere on the island of New Guinea was there any appreciable concentration of power or assertion of political centralization. Like the islands of Melanesia in their political atomization, their uniqueness, and linguistic diversity, New Guinea cultures showed little tendency toward political development.

The spread of modern culture, brought by airplanes and facilitated by networks of roads, has been very rapid. In the House of Assembly of Papua New Guinea, the highland peoples already present the challenge of greater numbers and newly released productive energy to the smaller groups of the coastal fringe and the neighboring islands.

An Iatmul man, right, and boy with face painted, below, prepare for an itiation ceremony. Middle Sepik Ri region, New Guinea.



AUSTRALIA

The first Aborigines settled in Australia at least 26,000 years ago, havi voyaged over water from Southeast Asia. When they first reached the new homeland, they must have hunted several species of giant mars pials that are now extinct. Stone tools have been found in Australia th show relatively little change right up to recent times.

The Aborigines have always hunted and collected wild foods. Th never practiced agriculture, but there is archeological evidence to sho that from about 10,000 years ago to the present, they adapted their eco omy to the localized resources in tropical, desert, and temperate region In desert areas groups tended to be small and often traveled over lo distances in search of food and water. In the tropical and temperate are the habitat was richer, and groups tended to be larger and more settle

In hunting, the Aborigines are famous for their use of the boomera and spear-thrower, two multipurpose and lightweight types of tools we suited to their foraging way of life. They lacked the bow and arro (except in one small part of Cape York), but made effective use of spea and clubs. Some groups still continue to make and use stone tools.

When Europeans first encountered Australian Aborigines they we surprised at the richness and variety of rituals, myths, music, and visu arts possessed by a people whose technology was perhaps the simplest i the world. Throughout Australia, myth is fused with religious life, so th many rituals are re-enactments, set to song and dance, of mythic events.

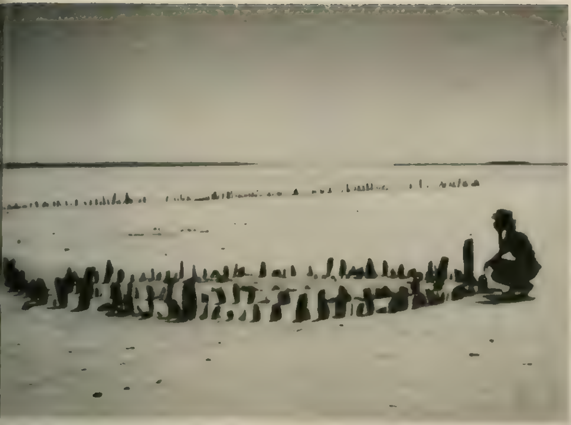
Arunta girl, central Australia.

The timeless, mythical past is called the "dreaming." The re-enactme of these myths through ritual is believed to cause the natural animal c plant species involved in the stories to remain fertile and multiply. Man of these rituals are closed to women, but are performed on their beha by the men. Male novices are introduced to the sacred mythology b stages, each stage marked by painful physical ordeals that vary fro group to group. On ritual occasions there is considerable use of bod painting as well as fabrication of sacred paraphernalia and rock and cav painting. These sacred objects include elaborate headdresses, strin crosses, and decorated poles that are believed to be the actual bodies mythical beings during the period of time that the rituals are in progres Ornately carved sacred boards and incised stones are also used in connection with these ceremonial events.

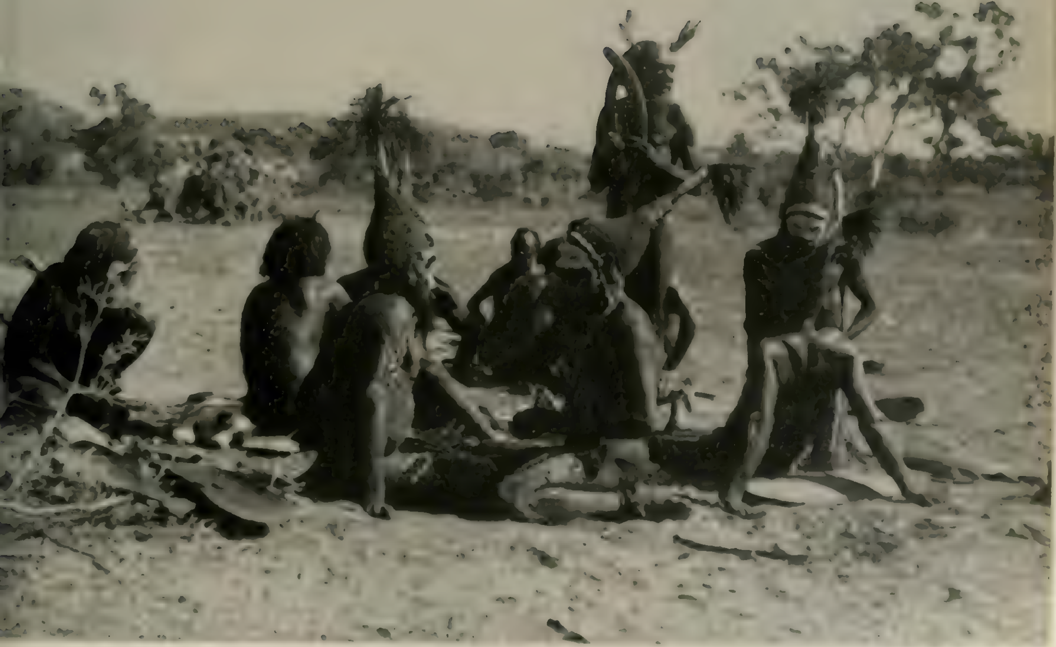
All Australian Aborigines share a belief in sorcery, and most group have individuals who practice "white" or "black" magic or both. Perhap best known is the practice of "pointing the bone," in which a sorcere aims a pointed object at his intended victim while singing a potent curse

Group decisions, particularly when they involve conflicts and marriag arrangements, are made largely on the basis of known kin relationship which also guide daily decisions about sharing food and locating camp Feuds sometimes develop and these can be settled either openly by direc fighting between the kin groups or covertly by sorcery. Among Aborigine there are no formal chiefs or councils of law. In daily life, there are n official leaders or privileged groups, hereditary or elected. Equality an sharing are emphasized, and everyone takes part in roughly the same sor of economic activities. Social prestige is determined by an individual skill in these activities and one's willingness to share the fruits of thes activities with kin. Both children and adults generally resent any form o authoritarian pressure, particularly from their peers.

While it is naïve to speak of the Australian Aborigines as "survivors o Stone-Age man," there is now ample evidence to show that they represent one of the most dramatic and best-documented cases of cultura conservatism in the world.



Regarded by Aborigines as an ancestral water snake, this ancient rock alignment, left, lies in a dry lake in Western Australia. Below, Arunta men prepare for a ceremonial re-enactment of the adventures of a mythical being.



INDONESIA

Balinese dancer.

Unlike the islands of the South Pacific, the two great archipelagic gions of Indonesia and the Philippines have contributed significantly the long and complex history of Asia. It is true that there are still comn nities where people live in many ways as they have lived for hundreds years, relying on bamboo and rattan and wood for most of the imp ments of everyday life, depending on fowl, pigs, and water buffalo These settlements tend to be relatively self-sufficient. Nevertheless, th are no peoples who have not in some way shared in a vast trade netw of iron, textiles, gold and silver, and beads, sometimes imported fr China by way of Central Europe. This network also involved power influences from the complex systems of religious and political thought India, China, and the expanding Islamic civilization. It would take whole museum to do justice to the complexity and beauty of the cra manship in textiles and metalwork, the elaborations of epic and scri and the diversity that has persisted, transformed but unbroken, down the present in Indonesia and the Philippines. It is possible to present o a few examples of these arts, and more complete collections that de onstrate the basic Malay culture characteristic of the whole area.

Today, almost all of the peoples of the two archipelagos are includ in the two modern republics of Indonesia and the Philippines. In th previous history they shared the same great traditions, which spre out from the great Buddhist empire of Shrivijaya, followed by the emp of Majapahit in Java. Contacts with China took the form of trade, f lowed in post-European times by the permanent addition of immigra from China. Regular trade with China is reported from the fourteen century, and Chinese pottery jars are cherished heirlooms both in t Philippines and in Borneo. Islamic kingdoms were established for a bri period before the arrival of the Spaniards. Java became primarily an lamic state, but preserved earlier cultural forms within the Javanese ve sion of Islam. It has been said that in Indonesia Islam did not construct civilization, it appropriated one. Alphabets derived from Devanagari a still used by the Hanunóo of the Philippines and by several other grou in both archipelagos. In Bali, where this is true, a distinctive form Hinduism still flourishes as well. Scripts of Indic, Arabic, and Rom origin coexist side by side with varying functions and degrees of use, marked contrast to the abrupt transformations from preliteracy to litera found in the more isolated areas of the Pacific. The arrival of the Port guese, the Dutch, and the English in Indonesia; the Spaniards and lat the Americans in the Philippines ushered in the period when many E ropean institutions were absorbed without the loss of the distinctivene of the various components of these archipelagic mosaics.

Throughout the centuries, the Malay core culture has shown extrao dinary persistence and toughness, and a capacity to continue older form of technology while at the same time incorporating selected elemen from the new. Each new period of change, based on influences from As and new local integrations and embellishments as well, also reinforce older cultural elements. The kris and the bolo are found throughou with both Indic and Islamic styles of weaponry manufacture and desig Textiles for the clothing that is essential for family, religious, and cou ceremonials reflect a tremendously rich variety of techniques and de signs, and a proliferation of local styles like batik, tie dyeing, double ti dyeing, and the use of the gossamer cloth made of pineapple fiber. Bat overlaid with gold leaf and bark cloth can still be found, as well as th ıble tie dyed intricacies of the Balinese Tenganan textiles, which com- e the most sophisticated technical form with the use of blood as a .

he use of metals is very old. Iron, tin, bronze, brass, silver, and gold e worked and reworked. Metallic objects and special instruments of and pleasure were imported from the mainland and were also manu- ured locally. Gold leaf from China was imported for the headdresses Balinese dancers. Plates from China are set in the base of Balinese nes made of modern cement, and the Tinguian medium strikes a plate n China to call the spirits. In post-European times, the Spaniards took d from the Philippines to Mexico. The whole area is characterized by diversity of handling metals and pottery, fiber and thread, design ele- nts that cluster and recur, enriching rather than superseding each er.

here are traces of precursors of man in Indonesia. *Homo erectus* of a dates back some 500,000 years. Pygmies were possibly the earliest n of our own species to settle here, but the small Negritos of the lippines now share the language and technology of their Malay neigh- s. The material culture of the earliest settlers may have been similar to t of the Andaman Islanders of the Bay of Bengal, a Pygmy people who e long isolated from mainland influences. But in Indonesia and the ippines one is everywhere reminded that there has been continuous rcommunication and modification made possible by the proximity great number of islands and the diversity of accessible environments, physical base of the cultural mosaic that emerged.

griculture in many forms is very old, and both various cereals and t crops such as yams, taro, and sweet potatoes were grown. Pottery made, but cooking was also done in bamboo sections and in beaten pper vats. It is the cereal rice, grown both in dry fields and on irrigated aces, that is the staple food of the area. Rice can be planted systemati- y, and is more easily stored and transported than the root crops on ch the rest of the Pacific depended. It could be weighed, measured, meted out, loaned and repaid with interest. Rice cultivation provided itable base for specialization, stratification, and elaboration of archi- ure and ceremonies. Religion was characterized by a close communi- on between the spirits of living people and those of the dead. This tionship was observed during trances with the help of ritual specialists. ial organization was differentiated by wealth and family rank.

ome groups who represent various aspects of the widespread and ic Malaysian technology have been carefully studied and the hall con- ns special collections from the Hanunóo, the Bagobo, the Ifugao, and er peoples of Northern Luzon. Materials from the Dyaks provide a hnological parallel in Borneo, and Islamic styles can be seen in the ss work of various Muslim groups bordering the South Sulu Sea.

n many other parts of the Pacific we find a greater gap between the hnologically developed European cultures and those of preliterate peo- s isolated from centers of civilization for thousands of years. In Indo- ia and the Philippines we find, instead, cultures of extraordinary com- xity, providing one of the finest examples of how continuous inter- ion among several religious systems and several technological tradi- ns, combined with the distinctiveness of the peoples themselves, has oduced a broad cultural base for the twentieth-century modern states, Republic of Indonesia, Malaysia, and the Republic of the Philippines.

Moro warrior, Philippines.

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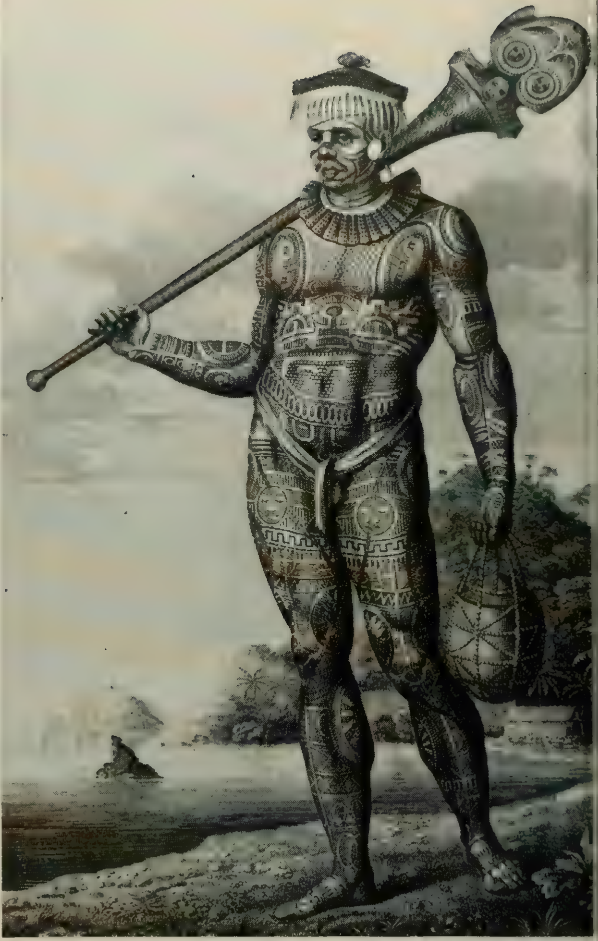
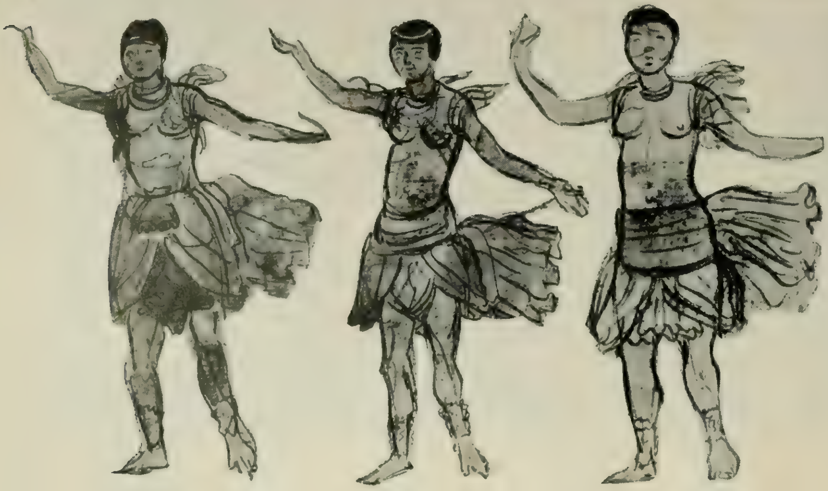
e, maturing in carefully irrigated nd fields, provides a staple food for Ifugao. These terraces and num-us settlements carpet the floor and ep slopes of the high valley of naue in Northern Luzon.

COLLECTING



A Nukahiwa man's classic Greek god pose, right, as well as most of the designs on his body, are products of a European engraver's imagination. The ethnocentrism so often reflected by nineteenth-century observers is slightly less obvious in the field sketch of Hawaiian dancers by Louis Choris, below. John Webber, who accompanied Captain Cook, 1776-1779, recorded a meeting with Hawaiians, far right.



nce the first voyages of exploration into the Pacific, collections of acts and drawings and accounts of the wonderful doings of the in- tants have poured back to Europe and the Americas. The earliest ages had a scientific orientation, and careful attempts were made to cribe the behavior and customs of the islanders. Along with these eavors there was casual and accidental acquisition of objects, such as pons, bark cloth, and carvings, by persons who were in the Pacific for r purposes: trade, whaling, warfare. This sort of amateur ethnology continued to the present day. These objects, many acquired by indi- als during World War II, are usually poorly placed and without umentation, but are nevertheless often unique and valuable. We may ect them to trickle into the museum for many years to come as people rt houses for apartments and as they lose interest in the trophies of r grandparents' journeys. Some of these specimens come into the eum one by one, others as part of larger collections, and their identi- ion is one of the tasks faced by museum anthropologists. Museums are bted to these casual collectors for many valuable specimens. For descendants of the peoples from whom the objects were collected, museum is a place where reminders of ancient skills are safe.

eanwhile the tradition, established by Captain Cook and by the kes expedition, of carefully labeling and cataloging collected speci- s continues. Early in this century German ethnographers were particu- active, bringing back huge collections with descriptive drawings or tographs to explain the uses of various artifacts. Feathers and plants e mounted and accompany such collections. These collectors did not y the individual peoples in detail and were dependent upon the ac- nts other people gave them. Many great collections have been built in way, but they belong essentially to a tradition that divorces what a ple make from what they feel and believe. Without supplementation n the work of those who study living peoples, such collections are ntially dead, although they do provide a valuable basis for the study nigrations, diffusion, and the use of animal and plant materials. This of study also has continued to the present day. Today many eth- raphers, in addition to doing detailed field work among a single ple, will make collections from the surrounding peoples.

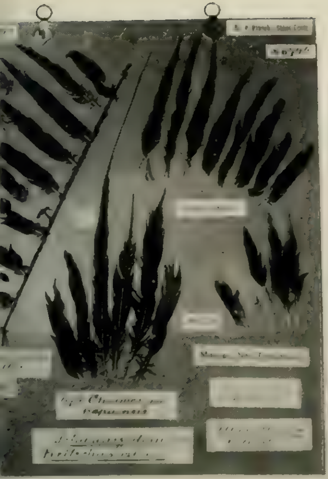
eginning early in this century, American, English, Dutch, and Swiss, as l as German, ethnographers began to combine studies of live peoples the collecting of artifacts. An arrow was no longer simply labeled the geographical name of the place where it was bought, but the nographers were able to tell whether it had been made there or

traded for, and what were the subtler and more ceremonial uses to which it had been put. It was possible to plot complicated trade routes, methods of barter and gift exchange, and the way in which one people simplified or elaborated articles that they traded from other peoples. Object still in use could be compared with objects that were found during the new archeological explorations. Old stone tools of which the present inhabitants knew nothing, such as the stone mortars and pestles found in the highlands of New Guinea, could be related to other excavations Styles that were actually undergoing a process of change when field workers were there could be documented, and thus old collections could be brought to life again. Photographs and films were used to illustrate actual craftsmen at work making masks or recording mortuary skulls studies of the way children were taught, and the ways craftsmanship wa established and styles conserved. The song a woman sang as she pounded rice in a mortar, could be collected along with the mortar, and the rhythm of the people's workday activities could be recorded.

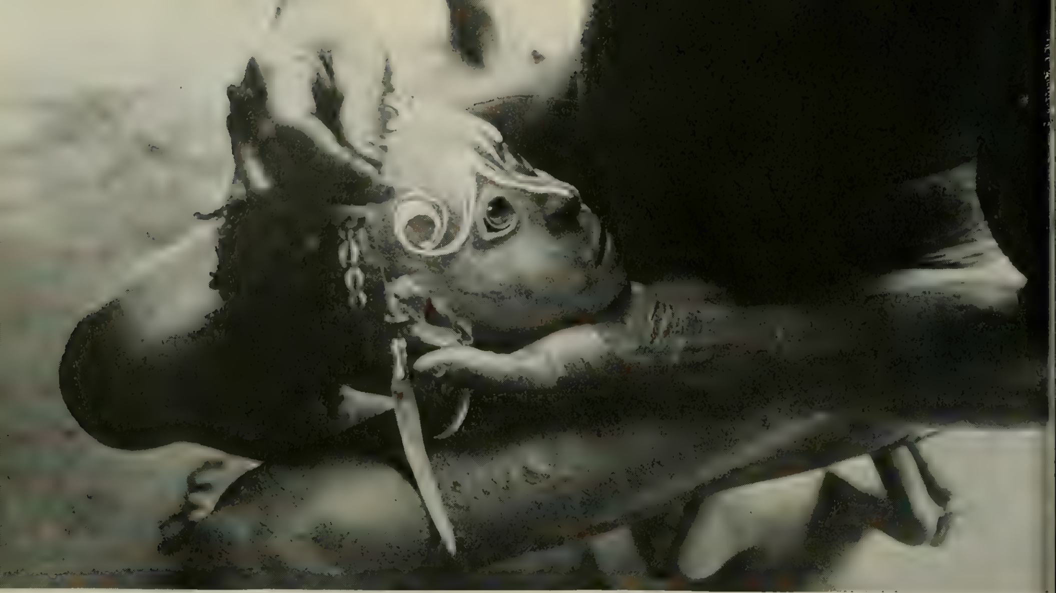
This general ethnographic approach, in which collecting is a part o field work, has been amplified during the last quarter century by even more detailed field research. In the Philippines, Harold Conklin has combined a study of the ethnoscientific categories of the people with the most meticulous photographic recordings of every step in agricultura processes. In Bali, Gregory Bateson's collections reveal the interrelationships between child rearing, artistic styles, and the ethos of the culture Filmmakers and photographers have spent many months working with ethnographers. In fact, the records of the skills and manufactures of a culture seem to be shifting from the objects themselves to audiovisua records of the way the objects are made, decorated, and used.

Yet, despite the exciting possibilities of these new methods of collecting, they do not replace the actual object, fashioned as it was by a skilled and habituated hand, as yet unconfused by the new techniques o the modern world. Side by side with field studies that measure the time i takes to cut down a tree with a stone ax, we still need the ax itself, so we can see its exact proportions, the way it is hafted, the materials with which it is hafted, and how they tighten or loosen with a change o temperature. No picture can fully replace the objects themselves, whether they are fishhooks or fish spears, nets with which birds were trapped, looms on which belts were woven, or samples of flax before it was twisted. And so, as we have widened and deepened anthropological and archeological field work, the halls of museums not only still have a place but have indeed a more important function. The extensive collections of plants important to the daily life of a people, carvings that display an individual carver's imagination, musical instruments—all represent something that is irreplaceable. These last far beyond the changes that each people undergo as they bring with them a part of their past, a part shorn of the old tools and implements, into their sharing of worldwide culture. Some future student will find a new significance in the rhythms of the designs utilized in the fretting of a lime spatula, or the potter's designs burned on the bamboo containers. Such objects cannot be preserved or made available for research purposes by even the most technically skilled photographers. Such things can be studied only because a large number of the objects themselves exist, to be held in the hand of a trained scientist or marveled at by small children who stand with their noses pressed against the glass.

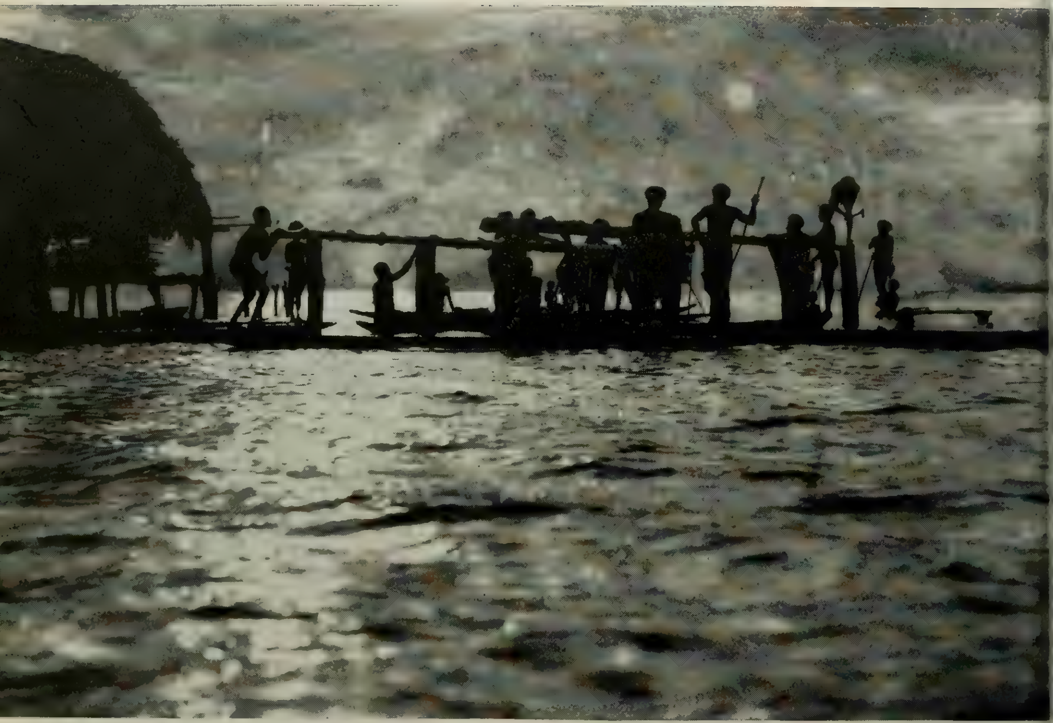
ater ethnographers augmented their tudies with photographs. Interior of a nen's house, Papua New Guinea.



Feathers, left, assembled by O. Finsch, 1898. Many large, carefully labeled collections of artifacts were amassed early in this century with little reference to the people who made and used them. Below, Iatmul children explore an anthropologist's field camp, 1938.



Some New Guinea people, like the Iatmul, model portraits in clay over the skulls of deceased tribesmen. Women relatives, above, mourn for a dead man, whose skull has been elaborately decorated, top. The skull is made into an effigy representing the deceased, top right, to be used in a ceremony of song and flute music staged by the men. When novices are initiated into the life of the ceremonial house, their faces often are painted with designs similar to those on the mortuary skulls, bottom right.



en Margaret Mead visited Manus in
8, some 2,000 people were living in
ages of pile dwellings built out over
shallow lagoon, top left. Community
was surrounded by water, bottom
. The canoe model, below, and the
rama of Pere village, Manus, at
ht, were constructed in 1930 under
ad's direction. Since that time, the la-
on communities have moved onto
d. Visiting the Hall of Peoples of the
ific in 1970, Paliau Moluat, now a
mber of the House of Assembly in
ua New Guinea, viewed the model
Pere village as it appeared during his
hood.

Preston McClanahan, fourth from right, and Margaret Mead, second from right, thresh out one of the details of the hall's construction.

THE HALL

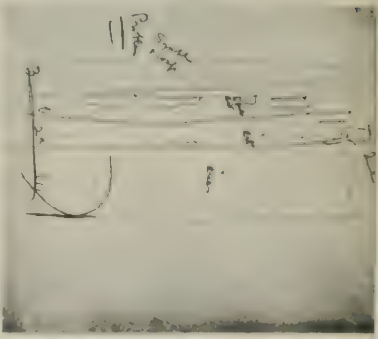
he hall, which opened in May, 1971, is the successor to two other s, the old South Sea Island Hall, installed by Robert Lowie in 1911, the Philippine Hall, constructed principally with materials that came n the St. Louis Exposition of 1904. The new hall is located in the old ippine Hall and now includes the entire Pacific. The old halls had -sized human figures made of wax and plaster, posturing among the ibited specimens. In the new hall, three scales have been used: the e of the dioramas, 3/8 inch to one foot; human scale, as armature to port a cloak or a headdress; and the wild, exuberant miniatures and ntisms with which the peoples of the Pacific carved, painted, and structed their images of the supernatural. These three scales are ob- ved carefully, so that visitors can orientate themselves and know where y are as they move from one exhibit to another.

he hall also inherits the acquisitions of the sixty years since Robert vie installed Finsch's little labels, just as they were, German captions all. Into the storerooms during those sixty years have come collec- ns made by museum curators, members of museum expeditions, and d ethnographers who have collected on the museum's behalf, objects cued from attics, special collections offered by dealers, and objects ained in exchange for American Indian artifacts of which the museum an abundance. What the hall is today has been shaped by what the seum already had or was given, could buy or exchange, and especially the special collections made on request, as well as by the design for new hall as it grew.

)nce it was clear where the new hall would be, and that one hall uld have to house the whole of the Pacific, specific areas were as- ied and the work with the actual islands and what the museum pos- ed from each one was tackled. The decision to make the hall bright light like the Pacific itself was inspired by an exhibition case in a small orical museum in Madrid in which a sword is suspended as if in the If the hall was to give this impression of lightness, of sky and sea, the es had to be as light and the frames as inconspicuous as possible. So bright ceiling of *leaf lite* and the mosaic floor, the Plexiglas armatures stands to support the specimens so that the structures would them- es almost disappear were what made the design really possible.

here was another interesting innovation, too. Because specimens from Pacific Islands are unbelievably fragile, it wasn't possible to construct ck-up cases and work with the actual specimens; they wouldn't stand handling. So the hall's designer, Preston McClanahan, perfected a v method. He built a model of the hall large enough to hold models the cases, and photographed the specimens in color to scale. Then y could be arranged like paper dolls, and the relationships between ors and forms could be experimented with freely, while the specimens in safety, untouched by human hands.

ound was another problem. The music of these diverse islands runs gamut from some of the simplest kinds of music known to the com- x polyphony of the Indonesian gamelans. Originally there was a plan put the music of each area (which meant the music to go with each a alcove) on the audiophone, and have only the sounds of the sea in hall itself, from the gentle lapping of waves to the pounding of reef akers and the occasional roar of a hurricane. But audiophones are table, sometimes working and sometimes not. It was decided to nge the plan so that sea sounds would intervene between the bursts area music that come from each alcove, in turn but not so close



The first concepts for a new Pacific hall were sketched by Mead nearly a decade ago together as to clash in listeners' ears. The sea sounds intervene betw one musical style and another, just as the isolation provided by the has made it possible for each island to develop its own art style.

The use of plastic and Plexiglas in the design of the hall has paralle Preston McClanahan's work as an artist, and his shows at the Muse of Modern Art, the Cincinnati Contemporary Arts Center, and the Wh ney Museum have involved the complementary uses of transparency a simplicity. The hall has grown slowly. He started working on it in 1 and there were many interruptions before the final push began in 19 But the sense of distinctiveness of each area has been preserved. The of the designer who deals with a dramatic presentation like a hall is ma easier if he is working with artifacts of human beings who are themsel masters of design. There is no feeling of artificiality in the hall. T presentation is, in effect, art, but art that becomes science, transform from one medium into another.

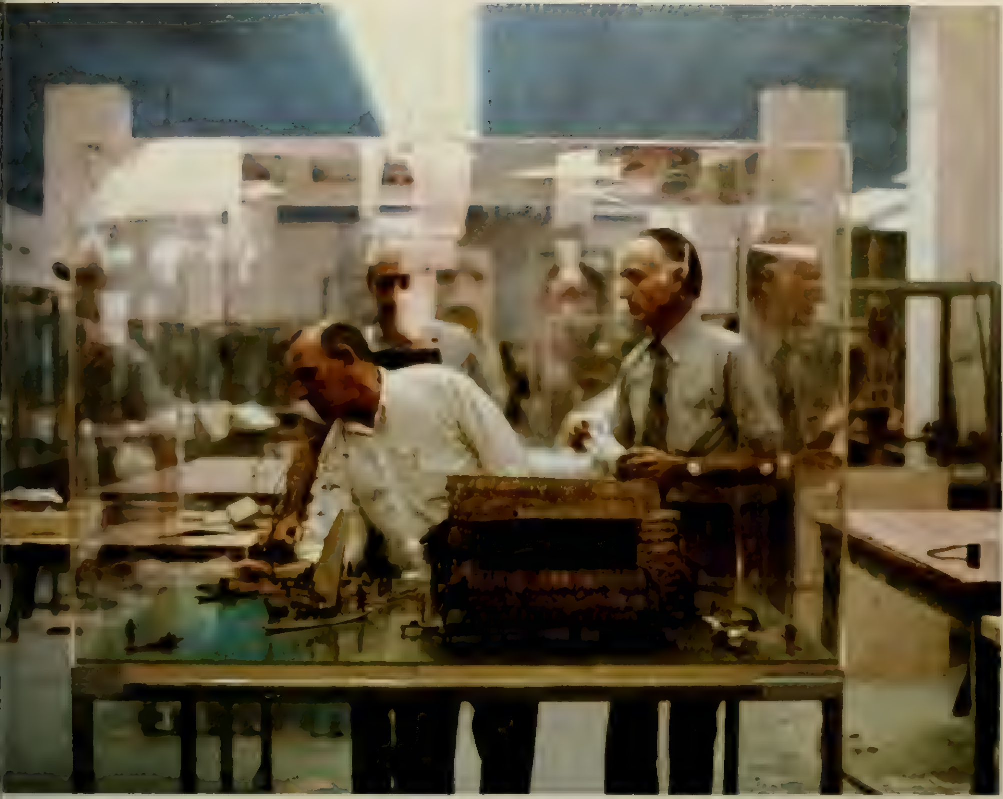
The films, photographs, tapes, and notes of field work have all playe part as background for the exhibits. Hours were spent studying data fr the 1928 expedition to Manus before the diorama of Pere village was b in 1930. When Margaret Mead returned there in 1953 to study changes that had taken place since the war, she took pictures of diorama with her. The villagers were greatly impressed, first by the curacy of the model and second by the miniature canoe resting in human hand. In 1959 a film was made comparing the old Manus of 1 to life there today, and the diorama, its glass case removed, was filmed color, the movement of the camera giving it a sense of life. Now all dioramas have been set on casters so that they can be wheeled out a photographed for television. Halls designed for television now add anot dimension so that millions may share in what is exhibited.

Ideas for the hall's design first took form in a detailed scale model

It was necessary to design the hall to the museum's existing collecti since so many of the cultures are now gone forever and no new colle ing is possible. A great deal of work had to be done to sift out the be authenticated artifacts, and often this meant a great deal of book wo cross comparison of catalogs, and poring over old sketches. Since 19 when the work started in earnest, whole generations of students ha come and gone. One student worker joined the hall's preparators as freshman with a National Science Foundation Fellowship. Years later, j about to take his Ph.D., he returned to the hall to work on the map which the newest archeological finds will be recorded year after ye The basic exhibition will stand as it is for years to come, but there h been provision for special exhibits, for the incorporation of new findin that will change the view of history, and for recording the independen that is coming, island by island, to the peoples of the South Seas. Lab have been kept to a minimum. A museum is a place to look and to pla objects in juxtaposition in one's mind, not a library in which to read, o film theater for viewing pictures.

A museum not only preserves the past of the people whose lives a chronicled there, but it also preserves the past of those who frequent halls. Unlike a play, a film, or a television broadcast, which once seen usually hard or impossible to see again, an exhibit is stable and the visit can return and find there what he remembers, now seen differently b cause he himself is more knowledgeable or interested in different thin

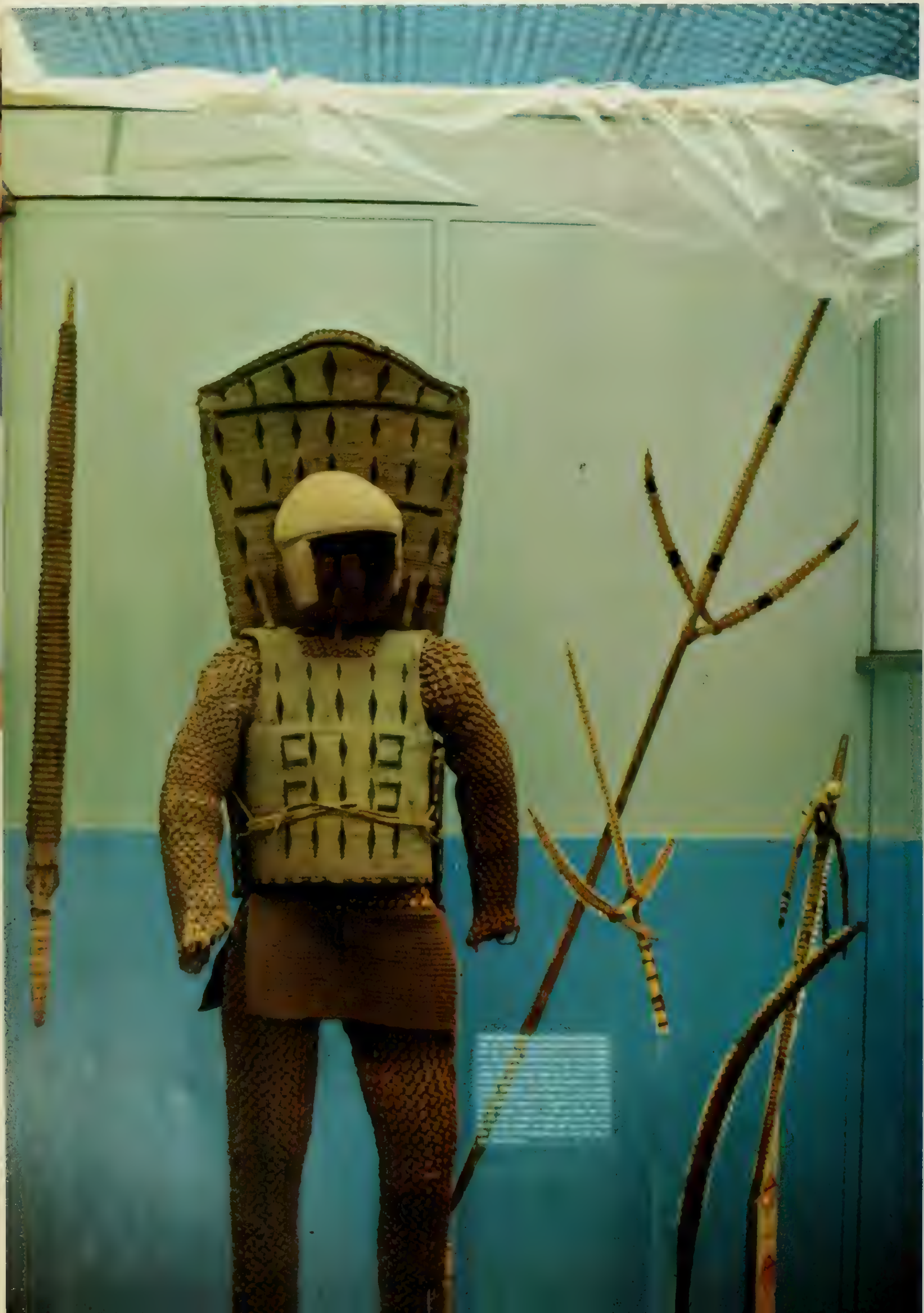
The hall has been planned to let the objects stand alone, as exampl of the handiwork of a people who have long since or just recently giv up their old skills and old beliefs for new ones, brought to them, as we the older ones, by people who sail the sea. Year by year visitors will b able to view the actual work of the Pacific peoples' hands. The work its will stand as a record of a once existing way of life.



village receives its clear plastic , above. A member of the Mu- 's exhibition staff adjusts the sup- of two Arapesh imported taro ders, right.

A carving of animal and bird spirits, left, which once adorned the interior of an Abelam ceremonial house in New Guinea, is readied for exhibition. On the façade of such houses hung rows of carved and painted faces of clan ancestors, below. A figure topping a New Hebrides headdress, left bottom, is set in its case.

Weapons edged with shark teeth and heavily knotted coconut fiber armor from the Gilbert Islands are remnants of Pacific wars of an earlier era.



ture Credits
—Philip D. Bogetto
—AMNH
—Ken Heyman
—top, Ted Schwartz; bottom, Robert
asse
—Richard Gould
—David Moore, Black Star
—Honolulu Academy of Arts
—top, AMNH; bottom, Honolulu
ademy of Arts
—Bernice P. Bishop Museum
—Ted Schwartz

45—Margaret Mead
46-47—Gregory Bateson
48-49—AMNH, Spencer and Gillen collection except 49 top, Richard Gould, courtesy of Charles Scribner's Sons
50—Ken Heyman
51—AMNH
52—Harold Conklin
54—top, AMNH; bottom, Bernice P. Bishop Museum
55—Honolulu Academy of Arts
56—AMNH, Capt. Frank Hurley

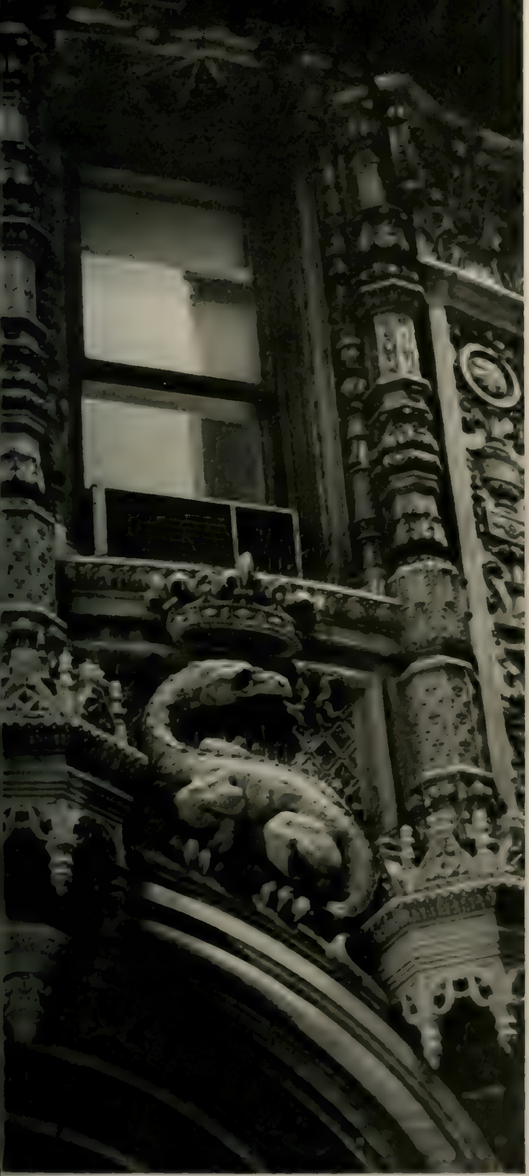
57—top, AMNH; bottom, Gregory Bateson
58-59—Gregory Bateson
60—top, Reo Fortune; bottom, Margaret Mead
61—left, AMNH; right, Ken Heyman
62—Stan Dworkin
63—Margaret Mead
64—Stan Dworkin
65-67—Preston McClanahan
68—Stan Dworkin
69—AMNH
70—AMNH

A NATURAL HISTORY MAGAZINE SPECIAL SUPPLEMENT

Thomas Church, 5th Avenue and 53rd Street

Thomas Church, 5th Avenue and 53rd Street

Belmont Plaza Hotel, Lexington Avenue and 49th Street



ourt, 182 West 58th Street

Manhattan Safari

photographs by Kay Simmon

New York City harbors uncounted numbers of animals that require no feeding, do not have to be groomed or dewormed, do not bark or whine, do not use the streets for toilets, do not inflict bites or scratches, do not love or hate. These are the sculptured images of animals that decorate the city's buildings, adding detail and whimsy to the streets of Manhattan for the curious and selective observer.

The variety of animal life portrayed in sculpture is astonishing in its complexity. Rats, which have apparently always had a share in the city's life, abound in its sculpture. Within a stone's throw of Grand Central Station, a decorative frieze depicts a rat nipping the toes of a man who is crying out in obvious anguish while hugging a beehive. The same Italianate border decoration shows another rat suffering death by hanging, evidently for the crime of covetously eyeing a seminaked chap and his money bag. Several blocks farther north, two wrought iron rodents, staging an assault on a modern office building, are thwarted by large cones attached to the canopy supports. Nevertheless, some of them seem to have succeeded. In another part of the same building, rats participate in a seemingly organized game of ring-around-the-rosy, eight of them posing prettily, their heads together in a charming rosette, while four others, unsuccessful in joining the game, skulk around outside the circle with their snakelike tails waving in an arabesque design.

A bit farther afield, but still within walking distance of Grand Central Station, two horses, now working for the International Brotherhood of Electrical Workers, seem convulsed by a joke they are trying to communicate to their boss, a Maya god. His expression of stern annoyance reflects their simultaneous chatter.

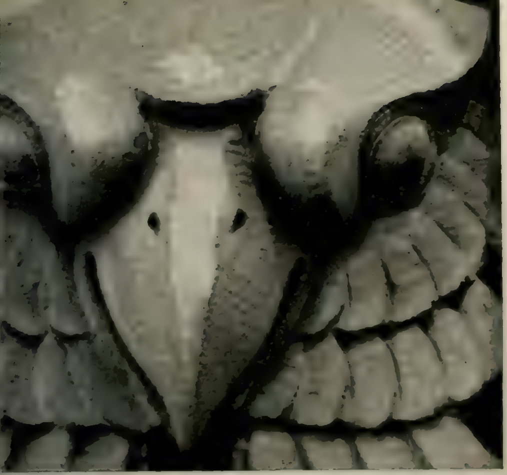
Bowery Savings Bank, 110 East 42nd Street

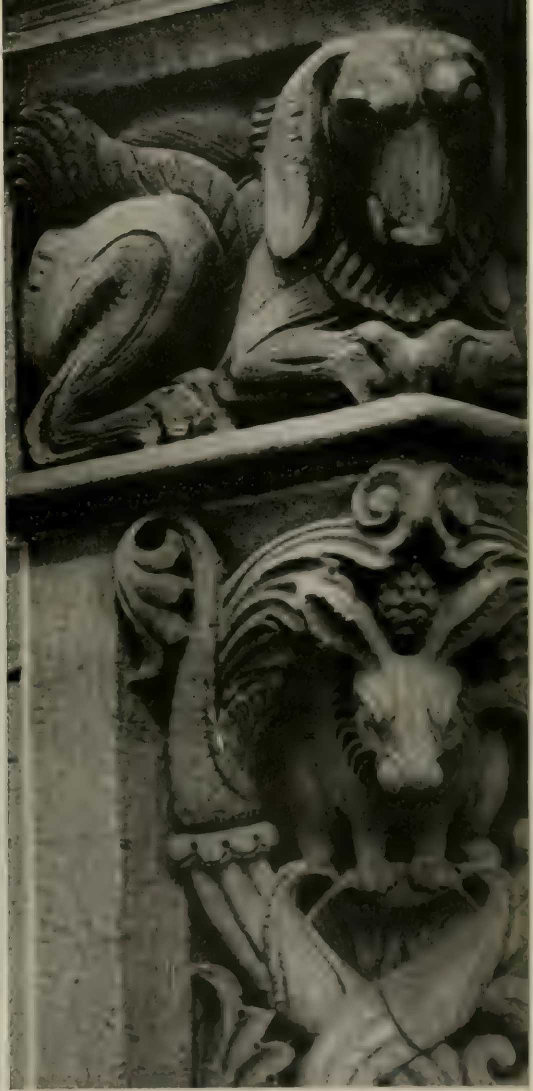
St. Patrick's Cathedral, 5th Avenue and 50th Street

136 East 79th Street

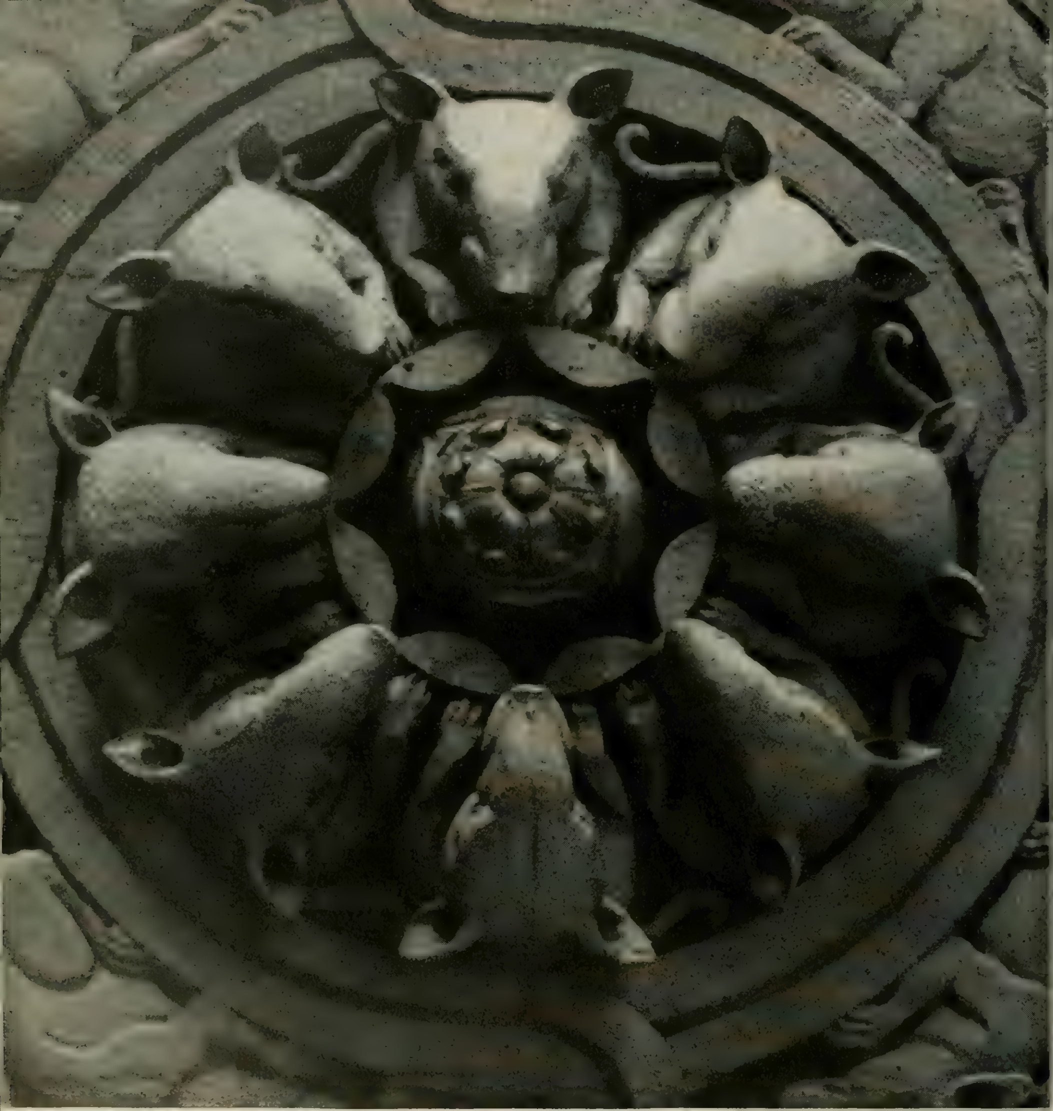
Very near Macy's, a French-speaking owl sits wide-eyed on the lower end of a frowning sickle moon declaring that everything will be just fine once it gets dark. An angry-looking bull, wearing a belly band for decoration, lives over an East Side bar, while a smiling bat seems to enjoy the view from the main entrance of an apartment house near Hunter College. In front of the New York Public Library, giant turtles, supporting large sculpture groups, toil with dignity, while at a midtown hotel four elephants cooperate amiably with the establishment by supporting flagpoles with their elegantly coiled trunks.

In rare instances, sculpture follows function; a converted old stable in the Murray Hill section exhibits not only two lifelike horses' heads but also a bulldog. All





All figures this page, 116 East 68th Street



aybar Building, 420 Lexington Avenue

anhattan Bank, 5th Avenue and 14th Street

Building, 420 Lexington Avenue

Jefferson Market Library, 425 Avenue of the Americas

of them probably once lived at that fashionable address.

Realism was clearly thrown to the winds, however, by the creator of the two bovines with a common head, which decorate an apartment house on lower Park Avenue. The complicated love life that such an arrangement must entail probably accounts for the air of resigned embarrassment. Venturing still further into the world of pure imagination, the elaborate encrustations on a large Seventh Avenue apartment house display several crowned dragons, presently enduring the ignominy of pigeon proofing.

New York City contains many more fine examples of architectural fauna for the interested hunter with a camera. Peacocks and squirrels, hounds and hares, rams and doves inhabit the city's streets and adorn its buildings. Although extinction poses a less serious threat to these specimens of stone wildlife than to the inhabitants of our parks and woodlands, it still exists. The stark simplicity of glass and steel buildings is not receptive to playful decoration, and progressively, the city's architectural wildlife is disappearing along with its habitat.

Sky Reporter

Occultation of Mars An occultation of Mars by the moon, in which the moon will temporarily cover the planet as viewed from earth, will occur during the morning hours of May 16 and will be visible in whole or in part from most of North America.

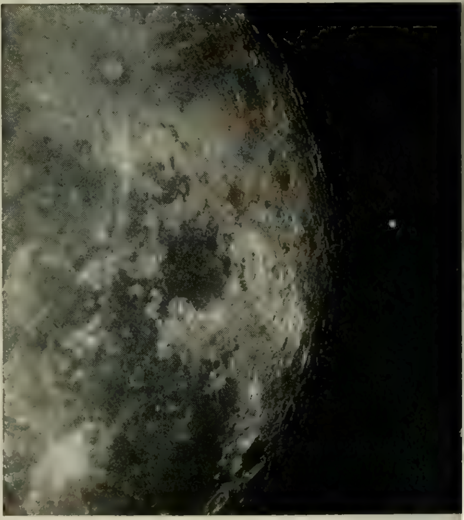
The waning gibbous moon, only about two days before last-quarter, will pass very close to the planet on the 16th. Technically, the moon will pass about a degree north of Mars at about 5:00 A.M., EST, when the two will be in conjunction. But that position is calculated from the center of the earth for the center of the moon. Because earth and moon are so close, the effect of their combined diameters is such that the disk of the moon will pass in front of Mars, as viewed from part of the Northern Hemisphere. For the rest of the world, the event will be just a close conjunction of Mars and the moon. But for observers in the eastern and central regions of North America, it will be an occultation of Mars.

Moonrise occurs shortly after midnight on the 16th, somewhat later toward the north. Mars will rise almost simultaneously with the moon, a little later and to the left. Both will be very close on rising, and both will then move up the sky together. But the motion of the moon in orbit around earth will cause it to move slowly left with respect to the surrounding stars and Mars. The moon moves a distance about equal to its own apparent size in one hour. This motion will take the moon closer to Mars after they rise, until the planet finally disappears behind the sunlit left edge of the moon, about in the center of the bright edge. For the next hour or so, the moon will slowly pass across the planet. Then Mars will reappear, this time emerging from the dark edge of the moon, at its lower right-hand edge, just a little to the right of where the bright edge ends at the terminator (the sunset line on the moon).

An occultation, somewhat like an eclipse of the sun, is caused by the moon's shadow. Not the shadow cast by the sun, but the shadow cast by some other celestial body's light, in this case the light of Mars. On May 16, the shadow of the moon cast by the light of Mars touches earth, and where it touches, Mars will be seen to pass behind the moon.

Since the moon is continually moving around earth eastward, its shadow is continually moving eastward through space. Thus the occultation occurs at continually changing times, progressively later to the east as the moon and its planetary shadow move in that direction. The duration of the occultation also varies along the path swept by the moon's shadow, depending partly on the speed at which the shadow moves across earth, partly on one's location within the shadow, deep inside or near the edge.

For these reasons, the time and the duration of the occultation of Mars on May 16 will vary. Along the West Coast, where the moon's shadow reaches first the event will begin before or soon after moonrise while the end, when the planet emerges from behind the moon, will occur at about 1:30 A.M., Pacific Standard Time. In the Plains States and the Midwest, the occultation will begin at about 1:30 A.M., Mountain Standard Time (2:30 A.M., Central Standard Time) and will end about an hour later (more or less, depending on location). Along the eastern seaboard, the occultation will begin at about 4:00 A.M., Eastern Standard Time and end about an hour or less afterward In general, the event occurs earlier to the west and



Mars, the tiny disk at right center, has just emerged from behind the moon in this 1911 photo. North is up in this view; the moon is moving left, away from Mars.

ter to the east within each time zone, and it will be
orter in duration toward the south. It would be wise
begin observing about half an hour before the
ove times. Binoculars or small telescopes will be a
cided advantage in finding and following Mars. Al-
ough the planet is quite bright (magnitude —0.4),
e contrast of the nearby bright lunar surface will
ake Mars difficult to see.

Thomas D. Nicholson

nning Down the Quasars If you look at something
n billion light-years away, you are seeing it as it was
n billion years ago. You see it, not as it is today, but
it was when the light you are seeing left it. You are
oking back in time, back to a time when the earth
d sun did not exist. The thing you are looking at
ay no longer exist. The prospect of looking so far
ck in time excites astronomers as much as anything
e about quasars.

For seven years astronomers have believed that qua-
rs may well be that far away. They have argued over
e evidence, and some have suggested alternative ex-
anations. Now it turns out that quasars almost cer-
nly are at the incredible distances they appear to be.

Quasar is a coined name for quasi-stellar objects,
uish points of light that look like stars but are not,
hich often emit strong radio waves. Many are vari-
le, with periods as short as a day; this can only
an that they are the size of the solar system or
aller. Most important, their light has been shifted
ward the red, or longer wave, portion of the spec-
m.

The red shift is what the argument is all about. All
tant objects in the universe—beyond our own galaxy,
at is—exhibit a red shift: the universe is expanding
d every object in it is moving away from every other
ject, and moving so fast that its light is shifted to-
rd the red. The farther an object is, say, from the
rth, the more its light is red shifted. This rule is
w well-enough established to be used backward:
ce we determine how much the light from an object
red shifted, we can say how far away it is.

The rule worked fine, until the astronomers figured
t the red shifts for the quasars in 1964. They sud-
nly became the most distant objects visible in tele-
opes. By itself, this was no problem. But astrono-
ers had other evidence that suggested the quasars
re comparatively small. For objects so small to be
seen at such distances they would have to be radiating with the energy of whole galaxies. (Our sun and all the stars we can see belong to one galaxy, best seen in the Milky Way.) No process known to physics could generate such energy.

So theorists searched for alternative explanations of the quasars, a way to make them "local" objects. The most promising line seemed to be the argument that quasars had been expelled from our galaxy in violent explosions and were still moving away so fast that their light was strongly red shifted.

Now a 32-year-old astrophysicist has found that a well-known quasar seems to be connected with a group of galaxies that are at the distance indicated by their red shift. James E. Gunn of the California Institute of Technology reported his work with the 200-inch Hale telescope in the *Astrophysical Journal.*

The quasar is known as PKS 2251+11. The name means that it was discovered at the Parkes Radio Observatory in Australia and that it lies at right ascension 22 hours 51 minutes and declination 11 degrees north. The quasar is in the middle of a small, compact cluster of galaxies.

Gunn has studied these galaxies, particularly the brightest one, and found that their apparent size and brightness correspond very well to the distance indicated by their red shift. He then argues that the quasar has the same red shift and that it would be too much of a coincidence for it to be simply lined up in precisely the same direction as the galaxies. He calculates that the probability is 1 in 2,000 of finding galaxies of the required brightness within half a minute of arc of the quasar and with nearly the same red shift.

He also argues that a wisp southwest of the quasar appears to be a cloud of ionized hydrogen, presumably excited by the quasar.

In a handful of other cases, galaxies are "suspiciously" close to quasars, but no one has yet done the spectroscopic analysis to see if they are, in fact, so similar that they must be together in space. Gunn feels that in the case of PKS 2251+11 he has shown that it is almost certain that the quasar is at the distance indicated by the red shift.

Now astronomers can feel more certain that when they look at quasars, they are looking back as much as ten billion years and seeing the universe in its infancy.

John P. Wiley, Jr.

Celestial Events

From full moon on May 10, the waning moon is a morning object, rising later each night as it becomes last-quarter on May 17 and new moon on the 24th. Emerging as an evening crescent a few nights later, it becomes the first-quarter moon on the last day of May, full again on June 8, and reaches last-quarter at midmonth.

In late May and early June, Mars and Jupiter (despite the fact that the latter is technically an evening star) dominate the morning sky scene. Jupiter is in the sky all night long, rising in the east after sunset. Just before dawn, however, it will be sharply brilliant in the southwest, while Mars will then be high in the southeast. Mars is now brightening rapidly as it approaches opposition in August, nearly doubling in brightness from mid-May to become almost as bright as Jupiter by mid-June. Mars will exceed Jupiter in brightness during July.

Venus, Mercury, and Saturn, the other morning stars, are all relatively close to the sun, rising rather late in the morning and still quite low as they fade into the brightening sky. Venus may be easiest to find from its brightness. It rises north of east at just about dawn. It may be possible to find Mercury and Saturn near Venus—Mercury nearby in late May, Saturn near Venus by mid-June.

May 16: The bright reddish star near the moon this morning is Mars. An occultation of Mars by the moon will be visible from North America (see page 78).

May 17: Saturn is in conjunction with the sun and enters the morning sky. It will be too close to the sun to be visible until mid-June. Mercury is at greatest elongation (distance from the sun) in the morning sky. The planet is only 11 degrees high by sunrise, but it may be found by looking near bright Venus in the dawn sky. Mercury is below and fainter than Venus.

May 22: Venus and Mercury are nearly directly beneath the moon in the eastern sky this morning. Both planets are in conjunction with the moon this afternoon.

May 23: Jupiter is at opposition. Directly opposite the sun in our sky, the planet now rises at sunset, sets at sunrise, and spends the entire night in the visible sky.

June 6: Mercury and Saturn, both morning stars quite close to the sun, are in conjunction, less than one lunar diameter apart.

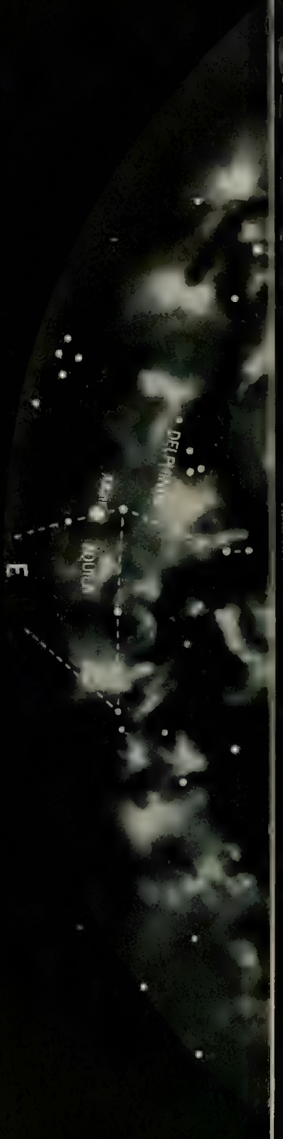
June 6-7: The very bright object near the moon on both nights is Jupiter. On the evening of the 6th, Jupiter is well to the east (left) and north of the moon. On the 7th, it is still north of the moon but now much closer to the west (right). On the night of the 7th, the star Antares is quite close to the moon, much closer than Jupiter.

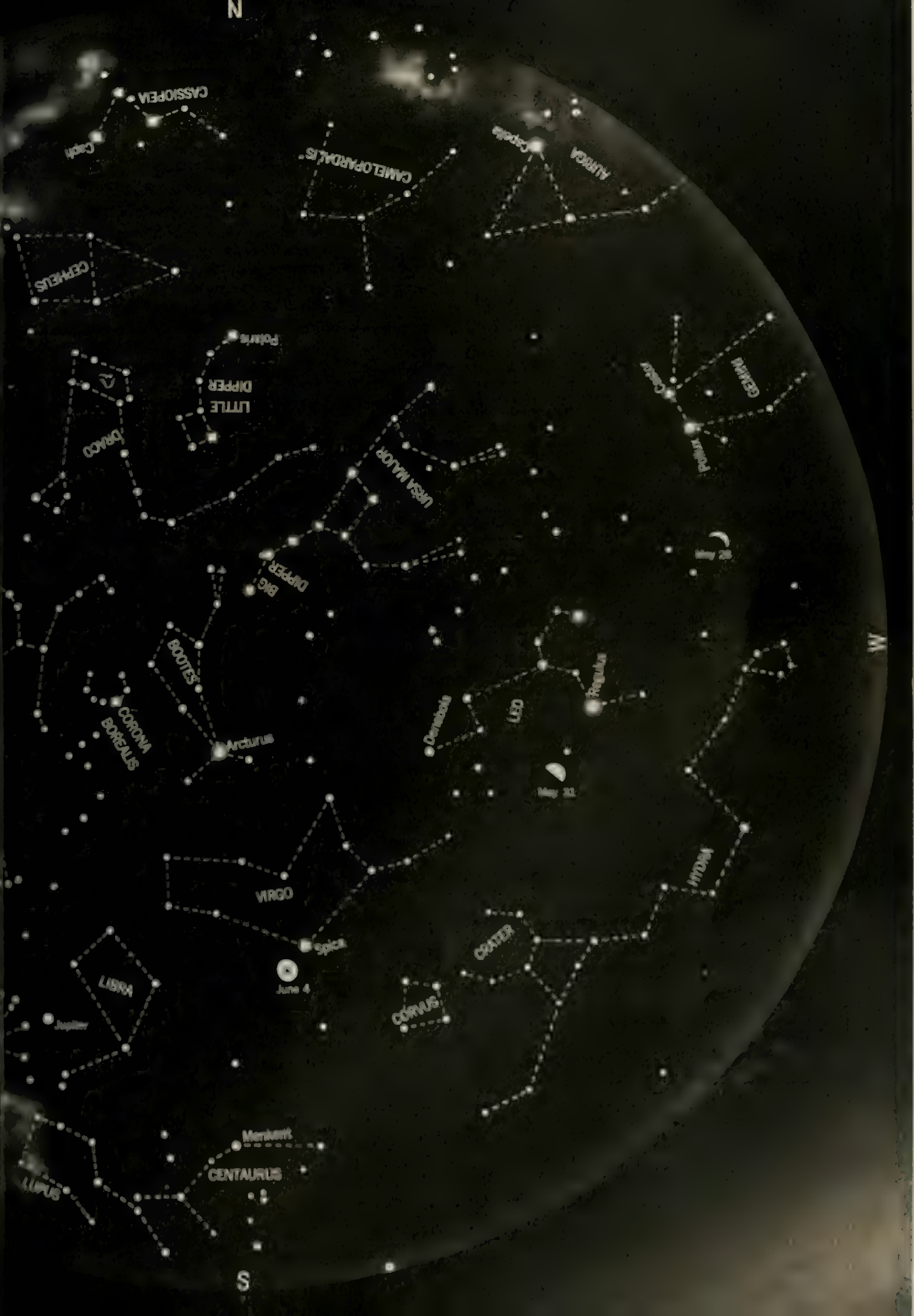
June 11: Venus and Saturn are in conjunction. If you find Venus in the morning sky, low in the east after dawn, Saturn will be just below it, about one degree (two moon diameters) away.

June 13: Look for Mars, quite bright, near the waning gibbous moon in the sky this morning.

Thomas D. Nicholson

★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky. The map is for 11:25 p.m. on May 15; 10:20 p.m. on June 1; and 9:25 p.m. on June 15; but it can be used for about an hour before and after those times.

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CAMELOPARDALIS
Capella
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CEPHEUS
Polaris
LITTLE DIPPER
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URSA MAJOR
Castor
GEMINI
Pollux
May 28
BIG DIPPER
BOOTES
CORONA BOREALIS
Arcturus
Denebola
LEO
Regulus
May 31
W
VIRGO
HYDRA
CRATER
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Hassles in the Park

Continued from page 23

volvers, riot guns, and clubs, they moved among the sleeping campers, singling out small groups of young people. Some youths were dragged from their tents and sleeping bags, handcuffed, searched, and beaten. Their belongings were scattered. One hundred and seventy-four were arrested. Bystanders who protested were threatened and silenced.

Among those protesting was Dr. John Fisher, a physician and former Republican state senator from Florida, who was sufficiently angered to report the incident in an indignant letter to President Nixon. Dr. Fisher, who had also witnessed the confrontations in Stoneman Meadow, condemned the brutality of the park rangers and law enforcement officers, and described the weekend behavior of the long-haired youth as "peaceful, polite, friendly, and pleasant." He blamed the Yosemite staff for the hostilities, stating that the weekend's confrontations would not have occurred without the unwise and antagonistic behavior of the park employees. He said that on the morning of the 5th, he had heard park rangers bragging about beating up some prisoners.

Responsibility for the July 4 weekend, however, does not rest only with the Yosemite staff. There is no doubt that among the half-million or so young people who annually visit Yosemite, there are a few who are openly aggressive toward anyone or anything bearing a resemblance to the establishment. There are some whose campground manners leave much to be desired and whose park behavior (either through ignorance or intention) invites corrective action by rangers. Some litter. Some drive loud motorcycles. A handful play their rock tapes after midnight. Many smoke marijuana. A few use hard drugs. Many come to the park with the intention of congregating in large groups, which causes a certain amount of environmental disturbance and creates a potential fire hazard. Then, too, some young Americans tend to be somewhat casual about nudity or "public displays of affection."

But a closer look reveals many parallels between the conduct of the
young park visitors and the beh
ior of older or more establishme
oriented segments of society.
longhair's loud and showy
torcycle, for instance, may be
more than a modest takeoff on
ostentatious 350-horsepower se
driven by the established fan
man. Littering is not an invent
of the long-haired generation; i
an American tradition, as est
lished as peanut butter or air po
tion. Hard drugs may be someth
different. But here again, a para
might be drawn with alcohol.
there may be validity to the con
tion that the common use of dr
is more of a commentary upon
social pressures and inequali
created by the over-40 generat
than it is upon the weakness
youth.

Other, more basic parallels
be drawn. Historically, the rang
criticism of the typical visitor
that he enters the park burde
with the artifacts and expectati
of his day-to-day existence,
isolating himself from the nat
environment. People of all
groups, all political leanings
hair lengths fit into this stereot
equally well, differing only in
objects and attitudes that they
into the park. Youth come equip
with guitars, tape recorders,
marijuana. The more traditional
itors bring in their mobile ho
(euphemistically called "campers
portable TV sets, playing cards,
and vermouth.

Some youthful visitors, who
parently feel somewhat out of pl
in the loneliness of the outdo
succumb to the group instinct
banding together in large numb
But this lack of individuality is
no means confined to the under
generation. Traditionally, the Am
ican camper spends 95 percent
his park visit within the crow
mass campgrounds, walking am
the souvenir counters and gift sh
or driving along park roads, sel
venturing more than a restroo
distance from his automobile.

There are differences, howe
and in the final analysis, the attit
and behavior of the Ameri
youth culture may be more in k
ing with the stated aims of the

sterling silver

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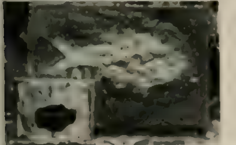

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tional Park Service than those displayed by the more traditional visitor. At Yosemite, for instance, the Park Service has long tried to persuade the park visitor to move away from the central campgrounds, swimming pools, and cocktail lounges in Yosemite Valley into the back country wildness, where he has a far better chance of learning something about the natural environment and of discovering the National Park System's reason for being. Within the last five years, this has been occurring. And, according to informal estimates by the Yosemite staff, this movement is largely a function of the long-haired camper.

Still, an attitude of suspicion exists between the park people and their youthful visitors. For some time the Yosemite staff had anticipated trouble with "hippies." And, as the President's Commission on Campus Unrest indicated, anticipation of trouble tends to create that trouble.

This anticipation may be subtle or confined to the ranks of park personnel: a staff memo, for instance, requesting that regulations against hitchhiking, loud mufflers, and "pets off leash," be more strictly enforced (no mention of hair length—but then, most loud mufflers come on motorcycles, most pets are brought by young people, most hitchhiking is done by those who can't afford autos). Other signals are clearer: a note written on the blackboard of the rangers' coffee room, "Power to the People—Ours!"; the increased hiring of police administration college majors to fill new ranger positions; an address given by a member of the park staff, who said he did not want "any hippies washing their dirty feet in my drinking water . . . we're damned well going to do something about it!" [applause]. At times, the anticipation may be visible to the public—the 7:00 P.M. curfew signs, the manner of conducting vehicle inspections, and the generally "attentive" attitude toward bearded or long-haired campers.

After July 4, the California press gave wide coverage to the youth-ranger conflict, perhaps serving to harden opinions that had already been formed in the minds of the combatants and the general pub-

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lic. Student newspapers, too, covered the issue. One student tabloid, the *Berkeley Tribe*, reacting to the park's vehicle inspections, the "daily pig harassment," and the "busts" of long-haired visitors, described Yosemite Valley as an "occupied zone," and lamented that "even the once serene parks and forests are not immune from the grip of the man." It went on to say: "The white man stole the land from the Indians, the Capitalists created cities of death, and now the hired assassin rangers are trying to rob us of our last sanctuaries. Guerrilla wars in the mountains are now becoming a possibility—there is no peace in a police state."

An impromptu group, calling itself the "Yosemite Liberation Front," issued a tongue-in-cheek call for a "10,000-freak army" for a Labor Day park demonstration.

The Yosemite staff's embarrassment following the July 4 weekend was due partly to the criticism they received for their handling of their youthful opponents and partly to their having been caught unprepared for the confrontation, so that they had had to call for police assistance from outside the park. They resolved not to be caught again, and the steps taken in following weeks revealed the official park conception of the appropriate means of handling large groups of young campers. Nineteen park police, specially trained in riot control and horsemanship were brought into Yosemite from Washington, D.C., and remained until after Labor Day. Twelve new horses were purchased and trained, and since most Yosemite rangers did not know how to ride or use police mounts, the Washington troops taught them. Gate crews paid particular attention to long-haired visitors and their autos. Sometimes they inspected luggage or forced hitchhikers to exit from vehicles before permitting the auto and driver to enter the park. (Although hitchhiking is not legal on federal property, it is legal elsewhere in the state of California.)

For the Labor Day weekend, 57 armed rangers were brought in from other western national parks to assist the 52 rangers already stationed in Yosemite Valley. Working overtime, rangers circulated contin-

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through the campgrounds.
rous $15 citations were issued
hhikers. Young people carry-
irewood (potential clubs?)
told to "put it back where it
from." Some young visitors
vehicles had passed the in-
ons given at park gates were
topped for reinspection in the
rounds and were then forced
ve the park. Once or twice,
nearby police departments re-
l groups of motorcyclists driv-
oward Yosemite. roadblocks
hrown across entrances to the
.

igers drove into the camp-
ds where large numbers of
people were camped, col-
throwing-size rocks, and
l them in the back of green
Service station wagons. In the
control headquarters, radio
iges came from rangers sta-
l at the park entrances, de-
ng suspicious "hippie-types"
d for Yosemite Valley. Dozens
wsmen—usually an indicator
ticipated trouble, often a cata-
walked slowly through the
grounds, carrying tape record-
d television cameras, smiling
vaving at the mounted police,
ng "peace" signs at the long-
l young people.

nothing happened.

hough there were large num-
of young people in the camp-
ids, "the enemy" did not mate-
. The three days passed
ut major incident, and in most
it was a normal Yosemite
nd. About 40,000 people en-
the park. Many stayed only a
ours, "doing" the park from
cars, but many others re-
d overnight, congregating in
nite Valley. The campgrounds
filled. The concessionaire's ac-
odations were filled. Gas sta-
cocktail lounges, and dining
were busy—pumping 45¢
serving $1.00 martinis and
steaks. In the big grocery store
semite Village—the store that
xt to the smorgasbord room,
to the bakery and wine shop,
o the snack bar, next to the pho-
phy studio, next to the moun-
limbers' shop, next to the post
, next to the visitor center, next
e jailhouse and rangers' office
ing—people filed among the
, buying flank steak and

panty-hose and copies of *Modern Screen* magazine. In front of the store, near the signs warning that "Bare feet are not permitted in this store" and "Shoplifting on these premises is a federal offense," smartly dressed women scolded their children for getting their new clothes dirty, and several members of a zealous religious group proselyted among the passersby, asking them to kneel on the sidewalk in "saving prayer." Office girls from Los Angeles, up for a weekend stay at Camp Curry, carefully removed their plastic haircurlers and then drove their convertibles, slowly and hopefully, around the valley roads. After two consecutive days of profitable business at Yosemite Lodge, a 40-year-old professional thief was seized as he walked through the lobby, a handful of jewelry in his pocket and his suit coat draped over the television set he had just lifted from one of the motel rooms. A little something for everybody. Or almost everybody.

But among the young people, there was an uneasiness, a concern over the park staff's attitude toward them, and in an indirect way, toward the environment.

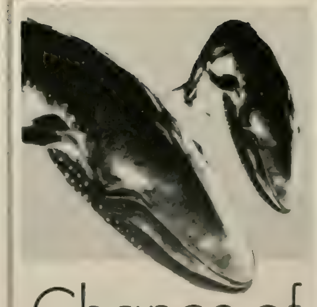
"Why can't *we* have a place in this park? Even a field? After all, they have all those hotels and swimming pools for the rich straights. But *we* can't afford them. And you know why we can't? Because we aren't greedy enough to go out and rape the environment and make a fat fifty thousand income, like a good capitalist should. We just want enough to live on.

"All that phony talk about protecting nature! If they're so worried, why don't they keep the cars out of here? Why pick on us? A hitchhiker doesn't bring any air pollution into the park.

"We get the feeling the rangers are looking to bust heads. We get the feeling they don't want us to do anything, not even hike.

"One of the rangers comes over. See? And he wants to see our food. So I show him the rice and the Granola and tell him that we're on Osawa's 'Number Seven Diet.' You know what he says? He says we're probably stealing, if that's all we have to eat!"

Final costs of Yosemite's elaborate security precautions for last



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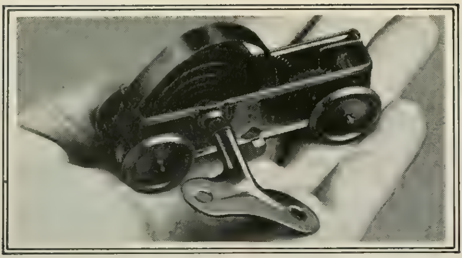

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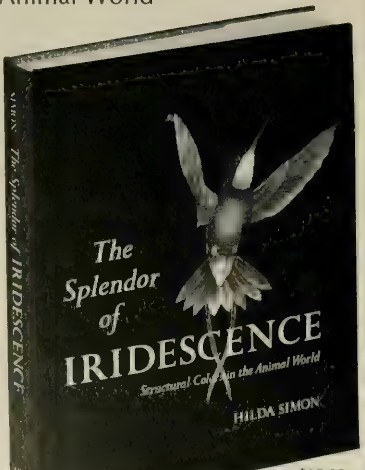
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summer range in the neighborh
of $270,000. For a low-prior
underbudgeted agency such as
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significant sum of money. It n
well detract from other progra
that are more in keeping with p
purpose, such as the park's "in
pretive" programs (slide sho
ranger talks, films, exhibits)
are designed to enhance the
tor's environmental awareness
to increase his understanding of
Park Service and its mission. C
$150,000 is budgeted for these.

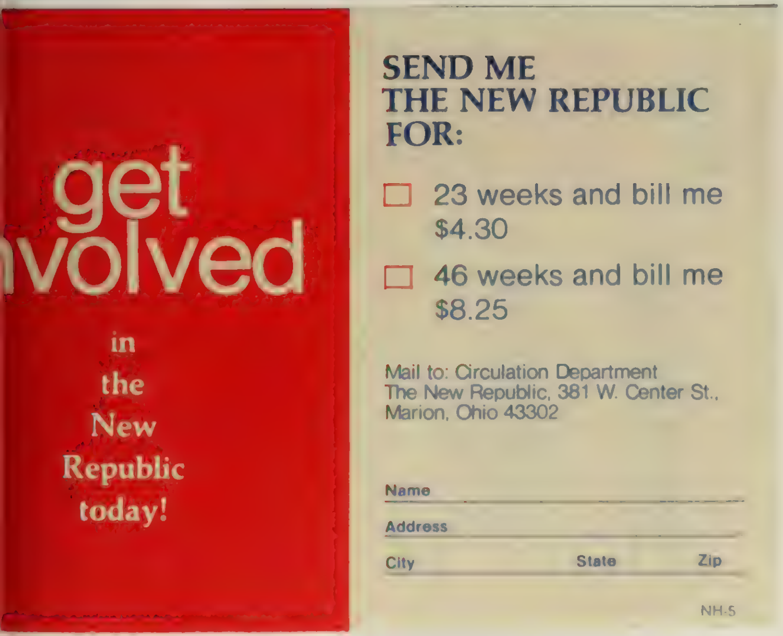
Among Yosemite staff memb
there are several who favor an
proach that emphasizes diplom
and communication, rather
suppression; who are critical of
hard-line posture and feel it
lead to the same intensification
hostilities that has occurred on
lege campuses. On Labor Day w
end, some park employees expre
the fear that the antiyouth poli
would weaken public support
other Park Service programs. A
who felt more strongly openly
demned the actions of rangers
participated in the events of
July 4 weekend, spoke contem
ously of "the orders to get the l
hairs," and talked seriously of q
ting the Park Service. Some tal
of "changing the system from w
in."

But like most of us, the majo
of park employees prefer not to
involved. They are paid to "d
job," and that job, they feel,
cludes the execution of a certain
of departmental regulations and
ministrative orders. They may
like wearing a revolver or drivin
police van, but after all, the w
is never all that black or whit
some of the young people *are*
tagonistic; they *do* break la
Then too, most park rangers h
families to support.

And so, the official position
dominates: "We've taken the
proach here, that they [long-hai
park visitors]—and this include
large number of them—that t
don't want to use the park in
way Congress intended.

"How did Congress intend?
gally. If they do things legally, t
there's a place for them.

"We can't provide a quality
perience for our visitors if a bu
of longhairs are going to come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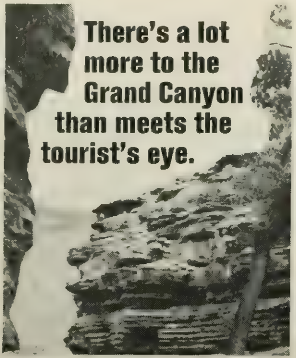

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and plunk themselves down in a campsite for the summer. They spoil the park for people.

"Yes, it's true that the 'straights' probably have a worse scenic impact on the park, with their trailers and other equipment, but they're also easier to control. The kids come in here hitchhiking. And our visitors shouldn't be subjected to hitchhikers. They're a traffic hazard. Besides, you can't control where they stay. You can't tell how many of them are using a single campsite. And don't forget, the people who steal are the ones who come to the park unequipped.

"It's unfortunate that — — told you the orders were to get the longhairs. That's not so. No statement like that came from *this* office. Of course, I don't know how the orders get changed as they go down through the lines.

"On the morning of July 5, we went into the campgrounds to restore them to a normal state. If we paid special attention to some people, it was because they drew our attention in one way or another. Brutality? There may have been some. I don't know. I was in the office at the time.

"They say 'you never talk to us.' Well, on the 4th of July, when they were in the meadow, lying around, we told them we would hold a special meeting in campground 14, at 6:30. What happened? Only twelve showed up. That shows you how interested they are in talking! They only want you to say what they want to hear.

"The future? I think the solution is to keep these people out. The simple fact is that too many people are using the parks today. And with that kind of a situation, we just can't afford to be all things to all people."

Within the scope of Park Service policy, the notion that parks "cannot afford to be all things" is a relatively new and foresighted concept. Its only value, though, lies in the extent to which it is logically and consistently applied. And in Yosemite Valley, where over the years the Park Service has permitted development of a multimillion dollar network of tourist accommodations, this logic and consistency are conspicuously lacking.

The valley's facilities, which range from the concessionair
motel rooms to special ca
and sewage disposal facilit
mobile homes, support the m
bound tourist's susceptibil
convenience and diminish th
ral flavor of the park. Thi
ation, with all its potential
volity and inequity, repres
blunt contradiction of state
Service philosophy. And
minds of some visitors, it fos
easy association between pa
icy and the traditionally mat
tic values of the establishment

From an environmental p
view, the Park Service is se
to such criticism. And with
last two years, some small, b
nificant, changes have been n
Yosemite, designed to com
crowded, busy, suburban
sphere. The number of ca
has been reduced. Auto tr
strictly controlled, and in
areas it is prohibited.

No amount of change, ho
will close the gap between
ite's staff and the park's youn
tors as long as the mutual
suspicions, and resentments
Still, the Park Service an
American youth culture may
more in common than is appa
first glance.

A significant portion of th
pute between young America
the establishment seems to
from widely varying concepti
the proper role of a nation'
nomic system and the place of
rialism as a social value. Perha
cause they have not been frigl
by a depression during thei
times, perhaps because they
witnessed their parents' psych
cal dependence upon a wide ra
material goods, ranging from
stoles to motorboats, perhap
cause they are aware of the
nomic inequality throughou
world or sense an inherent
tradiction between the private
of a corporate-dominated
structure and the social goal
quality environment, a large
ber of young Americans do
seem to be caught up in the
terialistic drives that have
nated American history. Relat
the past, there appears to be
need for private acquisition
more concern for the distrib
of wealth, more willingness t

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periment with communal life-styles.

Whatever the reasons, this is an encouraging trend for the welfare of the environment. And in this sense, in terms of the agreement between the world view of the long-haired generation and the environmental intentions of the National Park Service, there seems to be a valid political and philosophical link between the two groups.

Of all government agencies that have any dealing with the nation's resources, only the National Park Service has been given a mandate for nonmaterialism. By legal and administrative definition, the parks were created to furnish the public with a nonconsumptive form of recreation and with a sensitivity to natural life in a natural state, divorced from the notion of economic exploitation. The wildlife, vegetation, rocks, water, and soil within park boundaries are protected, not because they can be converted into dollars and cents, but for the sake of their own integrity.

And despite any of the Park Service's shortcomings, despite the fact that some of its staff members are more frightened by long hair than by air pollution, the agency still manages its lands and trains its personnel in a way that—for the most part—fulfills the nonmaterial intent of its founding legislation. It is probably safe to say that park rangers have less arrogant and less exploitative attitudes toward their natural surroundings than any other occupational group. To a ranger, a tree is still a tree, not a mere collection of "board feet" that can be cut into two-by-fours.

To the extent that there is conceptual agreement between the nonmaterial principles of the Park Service and the philosophical outlook of the long-haired generation, there seems to be a basis—and a reason—for communication between them. With dialogue, the park ranger may appear less of a "pig" and more of a human being; the shaggy visitor may appear less of a threat to society and more of an asset to the country's future.

This doesn't guarantee peace. By no means. But it does at least provide a talking point, something in common at the personal level, where prejudices are created, or destroyed. ■

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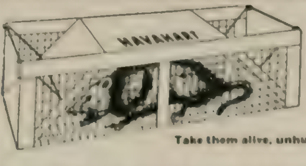

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Letters

A Touch of Humor

I was fascinated by the article "An Octopus Trilogy" in your issue of March, 1971, but much more fascinated by the photograph of coauthor Gennaro in the "Authors" section.

Could it be that the foot resting on the floor under Dr. Gennaro's chair is in actual physical contact with the late Professor Verrill? Or is Gennaro slightly less than three-eighths of the way to becoming an octopus himself?

James Fanning
Mount Kisco, New York

Stalking Scientific Accuracy

Your recent article on wild food plants by Euell Gibbons (February, 1971) did not show the kind of scientific accuracy that I have learned to expect from Natural History.

He writes that the sunflowers *Helianthus annuus* and *H. tuberosus* were native to the central part of North America and carried both east and west as cultivated crops. This is partly correct. First, it must be pointed out that *H. annuus* comprises two major groups, the wild sunflowers, probably native to the southwestern United States, and the giant cultivated sunflowers, which may have been first domesticated in the central area. Although *H. tuberosus* is often listed as a cultivated sunflower of the North American Indians, I know of no compelling evidence that would indicate that it was cultivated. Moreover, it was never carried to the west by the Indians. Further on, he states that "the young green flower buds" (heads?) of the sunflower were eaten by the Indians. I have not seen any reference to such use among the Indians, and I was under the impression that this was one of the first ways in which the sunflower was tried after its introduction into Europe.

The Jerusalem artichoke, *Helianthus tuberosus*, was not carried to Europe by the Spanish as Gibbons states. Apparently the credit for its introduction belongs to the French. The statement that *Jerusalem* in this connection is a corruption of *girasol* is frequently encountered, but some years ago R. N. Salaman presented evidence that such an origin cannot be accepted. He suggests it is more likely that the Jerusalem is a corruption of the Dutch name, *Ter Neusen*. Gibbons's opinion that "apparently [the Jerusalem artichoke] is in the process of giving up the ability to bear viable seeds," and that it is "almost wholly man's responsibility to disseminate the species" cannot be accepted, for the wild Jerusalem artichoke does produce seeds and spreads in nature by this means. Many of the cultivated forms also produce good seed.

Gibbons's comments on *Amaranthus* also require attention. Passing over his speculation on how the amaranths may have entered the United States, I should point out that although the seeds were used for food by Indians in this region, it is still an open question as to whether or not they were cultivated.

Charles B. Heiser, Jr.
Professor of Botany
Indiana University

The Author Replies:

Professor Heiser's letter does not show the kind of scientific accuracy that I have learned to expect from letters by scientists attempting to refute somone else's science. If he is going to insist that "it must be pointed out that *Helianthus annuus* comprises two major groups. . . ." then he should point out that these two groups are far from being immutable. The domestic type planted in the wild
quickly reverts to the wild
have seen this happen several ti

The best evidence that *Hel*
tuberosus was a cultivated pl
the Indians, and was also
both east and west, is the pres
the native type both east of t
palachians and near the India
of Arizona. Certainly these
were not in the original range
plant, so we can assume that
dians carried them. Fernald ar
sey, in *Edible Wild Plants of*
North America, state that the
lem artichoke was cultivated
Indians who introduced it to t
ropeans; and O. P. Medsg
Edible Wild Plants, says, "T
dians cultivated it for food an
ably introduced it in the East."

I have not seen the eviden
sented by R. N. Salaman that th
of the origin of the name *Jer*
through corruption of the
word *girasol* is "not acceptabl
am in error here, I am in e
some mighty good company, fo
ritt L. Fernald and a number o
noted botanists plainly accept
origin. The point is, however, th
plant is not from Jerusalem
not an artichoke.

I said, "Apparently the Jer
artichoke in the process of giv
the ability to bear viable seeds
Professor Heiser says this can
accepted. I hedged the stateme
"apparently" and "in the p
since I have closely observed
ber of patches of wild artichok
volunteers from the cultivate
for several years, both in Pen
nia and in New Mexico, an
never seen any evidence of a s
plant. Has Professor Heiser a
known of Jerusalem artichokes
from seed? At least he must
that it bears far fewer viable
than do any other members
genus *Helianthus*, and that

l justify my statement. He also flatly that the tubers were not ed to Europe by the Spanish, but e French. When? The Spanish in the range of the Jerusalem oke almost a hundred years be- he French were, and I find clear ls that this plant already had a history of cultivation in England 29.

o not believe that American In- cultivation of *Amaranthus* is much of an "open question." da Coxe Stevenson, in an article "Ethnobotany of the Zuni In- " which appeared in the 30th al Report of the Bureau of ican Ethnology (1908-09), on page 74 of "Amearanthus. they raise in their gardens d the village." She was first g the Zuni in 1879.

EUELL GIBBONS

e article "On the Trail of the Sisters" in your February issue TURAL HISTORY was quite inter- . However, only slight knowl- of edible plants has led many into severe cases of internal ning.

garding poke (*Phytolacca ameri-* , the young tender leaves and can be quite edible as cooked s. But the entire plant is poi- s. The poisonous principle is st in concentration in the root. less in the leaves and stems, and in the fruits. This is one of the dangerous poisonous plants in nited States, because people eat aves without proper or complete g, or accidently pull up and ots with the leaves. Raw berries ause serious poisoning; cooked s, however, are edible. Symp- of poisoning are generally se- stomach cramps and pain, nau- with persistent vomiting, ea, slowed and difficult breathing, and weakness, leading to spasms, severe convulsions, and death.

In the use of the ground cherry (*Physalis* spp.) the ripe fruits are edible. However, the leaves and *unripe* fruits are poisonous.

I would like to add a few rules to assist the plant collector and gourmet in avoiding plant poisoning:

1. Do not eat wild plants unless *positive* of identification.
2. Do not rely on pets, birds, or other animals to indicate nonpoisonous plants.
3. Know the plant before eating any part of it.

Native poisonous plants are still plentiful in our natural areas. Many outdoor recreationists are one or two generations removed from the wisdom of their rural forefathers. With increasing numbers of urbanites camping and hiking in the outdoors, poisonous plants still cause over 3 percent of all poisonings.

For your readers interested in additional information on human poisoning from phytotoxins, I recommend *Human Poisoning from Native and Cultivated Plants*, by James W. Hardin and Jay M. Arena, M.D., Duke University Press, Durham, 1969.

SMITH FALCONER, JR.
Director, Regional Parks
County of San Bernardino, California

Impartiality or Hypocrisy?

I am not sure whether I should admire your impartiality or criticize you for hypocrisy. I refer to the ad, which has appeared for two months now in NATURAL HISTORY, for Deltona Corporation's "total community" at Citrus Springs, Florida. While I realize that you depend greatly on advertising revenue to stay in print, I really think that this particular ad runs completely counter to what other pages in this and other issues of NATURAL HISTORY are saying. Page 56 in the March, 1971, issue is the start of an article on "Ecocide in Indochina." Couldn't page 5 (the ad) be termed a type of ecocide in Florida?

In spite of this (although difficult), I do enjoy your magazine.

MARY E. MONTGOMERY
Oberlin, Ohio

Behind the Florentine Codex

We at the School of American Research have read with great interest Dr. Harvey's outstanding review of the *Florentine Codex* in the December NATURAL HISTORY. I would like to point out the role of our school in developing this publication series.

In 1938, Dr. Edgar Lee Hewett, then our director, instituted work on the project by having the entire *Codex* photographed in Florence. All subsequent work on the translations has been done from this photocopy. The project was put aside during World War II, but in 1947 Dr. Hewett's successor here, Dr. Sylvanus G. Morley, reached an agreement with the University of Utah under which Dr. Arthur J. O. Anderson of our staff and Dr. Charles Dibble of Utah would work together on the translations.

The first volume of the series, published in 1950, and the next four volumes were printed by the University of New Mexico Press, and the School of American Research acted as publisher. Later volumes have been printed by the University of Utah Press as a joint publishing venture with us. We are naturally proud of our role as originator and major sponsor of this important project.

PETER DECHERT
Assistant Director
School of American Research
Santa Fe, New Mexico

ne Great White Hope

n to the sea in cages to seek an
unter with the elusive great white shark—
-foot, cadaver-colored, awesome beast

illiam F. Herrnkind

MERIDIAN, by Peter Matthies-
andom House, $8.95; *204 pp.*,

great white shark, *Carcharodon*
-harias is truly an awesome and
me beast. Consider, for in-
his magnitude: he is known to
a length of more than thirty-six
nd has an enormous girth and
aws arrayed with large, keen-
doubly serrate, triangular
The tooth I am scrutinizing at
iting is some three inches long,
ave been told by colleagues fa-
with the species that this single
n from the great white's arsenal
n a not-so-big specimen, cer-
one less than twelve feet. Then
is his appearance: he is un-
ably sharklike, morphologi-
adapted for continual, rapid
ing. His snout is conical, the
e body torpedolike and stream-
while both lobes of the large
fin are nearly equal in size (a
ter of the Isuridae, a family
ncludes the mako, a splendid
sh). Even more alien are the
like black pits set against the
ray body, a color Matthiessen
es as that of a "cadaver." Add
enormous size and ghastly ap-
ice an unpredictable nature and
documented case history of man-
and there is hardly need to
e a more chilling beast.

ertheless, there remains con-
that, cruising in the deep
there is an even larger species,
rias megalodon, generally con-
l extinct, known to have at-
lengths up to eighty feet. Although the study of marine life *in situ* has not been author Peter Matthiessen's line, it is easy to understand his succumbing to an intriguing undersea venture.

In *Blue Meridian*, Matthiessen presents us with the narrative of an expedition that went out to seek, and film in its element, the great white shark: largest, most voracious, and most feared man-eater of the oceans. But, unlike most shark-diving stories—dramatized, romanticized, and exaggerated—*Blue Meridian* is subdued, analytical, truthful, and intimately personal. The adventure is portrayed in the light of Matthiessen's impressions of the real-life characters, their spirit and foibles, and is highlighted by sparkling prose. Excerpts from the diaries of others on the expedition are blended into the story, providing both insight into their characters and adding elements not experienced by the author. Throughout, one learns considerably about the natural history of sharks, whales, professional divers, and other such creatures of the sea. The 52 color photographs are excellent, and reflect the over-all quality of the book.

Matthiessen explains that the Blue Water Films expedition was organized by Peter Gimbel, a well-known diver and underwater photographer whose photos of the then recently sunk *Andrea Doria* graced the pages of *Life* some years ago. Gimbel obtained financing for the production of a high-quality, undersea film of large, dangerous sharks at various locations around the world; its pièce de résistance would be footage of the "white death," the name by which *Carcharodon carcharias* is known to Australian divers.

The crew members, in keeping with the quality product sought, included several of the world's finest divers and underwater photographers. There is no room for amateur thrill seekers in most undersea work and most certainly not on the Blue Water expedition. I have to be impressed by the technical talent personified by such divers as Rod and Valerie Taylor, spearfishing champions of Australia, and by Gimbel himself. Stan Waterman, an American diver-photographer, is much respected for his underwater photography. Much of the book expresses the thoughts, actions, and nature of these remarkable people, and the reader cannot help but realize that success and avoidance of tragedy during risky activities is due, not to fortunate circumstance, but to the awareness and competence of the individuals involved. Matthiessen explains that he is a novice diver, but game. Certainly he is a most qualified observer of man and nature. He writes as though he was impressed more by the human element than by the thrill of swimming among enormous man-eating sharks.

The story begins on the whaling grounds in the Indian Ocean off South Africa where it had been called to Gimbel's attention that the tethered dead whales often attracted hordes of large sharks. Such voracious feeders are capable of stripping the flesh of a whale down to the backbone in a few hours. Here the author

QUESTAR SPIES ON A BALD EAGLE

— brooding on his fate, perhaps, as he surveys his dwindling domain?

The photographs were taken by Ralph L. Shook on a bitter cold day in February, with the wind at 15 miles per hour. He spent many hours waiting for his eagle to visit this favorite perch. The picture at the right shows the whole scene with his Kodak Instamatic — his Field Model Questar set up in a blind, 150 feet from the bird's tree. His modified Nikon with through-the-lens meter is close-coupled to the telescope and the arrow points to the empty branch. Above, the Questar photograph is cropped from an 8 x 10 enlargement of 35 mm. Tri-X, taken at f/16, 1/250 second.

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dwells at length on the decline whales and whaling and on the ra climate of South Africa, both which conditions he abhors. Altho the expedition succeeded in obtain spectacular footage of blue sharks ger sharks, and oceanic white t the great white did not put in appearance. The expedition t traveled to Ceylon, Madagascar, Seychelles, and Mozambique with obtaining any outstanding res Worst of all, *Carcharodon car rias* continued to evade them. Du this period several accidents occu and the author records the proces morale deterioration caused by an ty. Finally, the decision was mad seek out the great white in the off South Australia, which it is kn to frequent.

Until this time Matthiessen give only a partial picture of the g white: size, appearance, distribu Now we read about the white d and perceive the mental image th the composite of experiences rel by those who have seen the b those who have seen their friend tacked and killed by him, and t who have found themselves in jaws, yet survived to give their pressions. It is an effective presenta so much so that one shares crew's apprehension at confronta Formerly, the photographers had l ly left their shark cages to film blues, tigers, and white tips, w one of the divers merely prodded approaching sharks away. Close were even taken in blood-stained ter as ten- to fourteen-foot sh gobbled flesh from the wou whales. Now, however, everyone s ingly became ultracautious and were content to film from the ca No one entered the open wate defy the beast. But in the end, the pedition succeeded—the challe were met and the aura of mys surrounding the search, and the g white, was stripped away.

Among the many facets of the that impressed me were the comn by Matthiessen and the others a diving and divers. Based on my work-related diving experiences the past ten years, I believe the pressions given reveal the thou and actions of the professional For example, Gimbel enters the w for a dive when he feels domi over the conditions at hand, not he is fearful. Indeed, one often merges with apprehension, but should be aware of the influence state of mind exerts on his per ance, since he may well jeopa his life and the well-being of hi divers. Val Taylor states that she w dive with Gimbel and Waterman

THE WAR COMES HOME

WE ARE RIGHT SMACK IN THE MIDDLE OF A HEROIN EPIDEMIC

lethal powder—the "white death"—has spread to all levels of American society, with the syringe becoming uch a part of suburbia as the Saturday afternoon barbecue. There are half a million addicts walking streets right now. They will spend $15 million today feeding their habit. They'll get more than half this money crimes they'll commit in the big cities. One of every four of these addicts is a teenager, and for the 18-35 group, heroin overdoses have become a major cause of death.

is terrifying. But it isn't news. Every time you turn on the TV or pick up the newspaper you hear about heroin. ators rise regularly to read grim statistics into the Congressional Record. President Nixon himself has en somberly about the way heroin is stalking our streets with "pandemic virulence."

ll this talk isn't going to change things. Neither is sending Henry Kissinger to Turkey to see what can be done it the Middle East opium field. And the President probably knows it. The heroin problem is going to get e, with more young people becoming addicted and dying, until the U.S. gets out of Southeast Asia. Heroin and Var are connected with a horrible symbiosis.

May issue, Ramparts magazine tells the shocking story of the New Opium War:

- how clandestine CIA involvement in the parapolitics of Southeast Asia has allowed this area to produce 80% of the world's opium, replacing the Middle East as the major source of heroin.
- how a U.S.-sponsored network of anti-communists—Meo tribesmen in Laos, nationalist Chinese guerrillas and Burmese border police—participate in the opium harvest, in its processing into heroin and transportation to checkpoints throughout Indochina and finally to the U.S.
- how the major figures in South Vietnam's government—from Diem and Madame Nhu in the past to Nguyen Cao Ky today—have profited from the heroin traffic with tacit American support.
- how Saigon has become a major stop along this new heroin route, with up to 20% of some American GI platoons coming home addicts and at least one soldier a day dying from overdoses.

New Opium War" is another example of how the war comes home, wrapped in lies and distortions and ging chaos with it. It is also another page in Ramparts coverage of the ever-deepening U.S. involvement in heast Asia. We began in 1966 (before opposition to the war was fashionable) with the expose of the joint ts of Michigan State University and the CIA to set up the Diem regime. We will continue until the killing is over.

If you want to know more about it, read our May issue, on sale now. Or better yet, take an introductory subscription: 10 issues for $4.75 (regular price $7), which we will begin with our current issue containing the opium story. Let us throw in, free, a copy of "2, 3, Many Vietnams", by the editors of Ramparts (Canfield Press, $3.95). That makes the deal worth about $12, but it's yours for $4.75, saving you over 60%.

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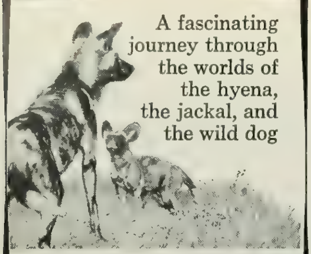

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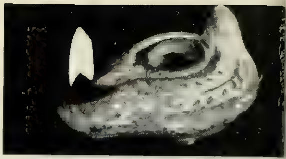
where because they are "aware." Gimbel proclaims Ron Taylor a superb diver because he anticipates.

An example of the importance of this confidence between diving buddies was demonstrated during the recent Tektite-2 undersea habitat operation in the Virgin Islands. As potential aquanaut-scientists we were not asked to perform diving feats; our records clearly stated our background and experience. Instead, team members were asked to go on dives together under the scrutiny of the safety officers to see whether, in their words, we were comfortable in the water. Final acceptance to live for three weeks underwater in a saturated mode, where accidental surfacing could easily be fatal, depended in large part on the trust and confidence each individual inspired in his team members.

The emotional link between divers is apparent from several accounts in *Blue Meridian* of individuals who became temporarily lost. In such situations the diver who unexpectedly finds himself alone may think, "I know where I am, but where is my partner? What horror may have overtaken him while I diverted my attention?" The anxiety generated prevents further work and sets the stage for disasters. For this reason the "hero" diver who independently decides to take chances or who is unpredictable is to be avoided; he simply places too great a burden on his partner.

Some readers may consider the whole expedition foolhardy and the idea of entering the water with large, feeding sharks as being beyond the limit of sanity. Even the spouse of one of the crew members expressed the opinion that such adventuring was childish. Yet the group tested the consequences of each new step before, literally, plunging in. I am unwilling to go so far as to validate their sanity but, at least, the methods of their possible madness were rational.

Out of all the risks came a number of potentially valuable observations on shark behavior that should be repeated. Perhaps the most surprising point offered was that divers should not play 'possum in the presence of a large shark but should remain active, vigorously prodding it away if it approaches. The experiences of the Blue Water crew and those of other divers and shark researchers bears out the success of prodding to avoid being bitten or roughed up by large sharks. The rationale is that although the sharks are predators, they are not neurally arranged as are lions or wolves, and will not respond equivalently to the same stimuli. The



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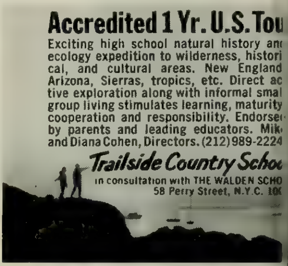

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ɔrman Evans just gave birth to a six-year-old.

an is a bachelor. A bachelor with heart. A that stretches from an apartment in New City to a mud-and-straw thatched house in ı. A heart that has made room for a six-year-ımed Choon Hae Lee and his family.

makes me feel very rich," Norm says. "And I mean in money."

ve the Children Federation agrees with Mr. ;. That's why they found him Choon Hae. ne nine people living in two rooms with no ng water. Imagine a six-year-old walking two to and from school. Imagine a village with edical facilities. Only then can you start to rstand how Choon Hae Lee must live.

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lion is provoked when you push a stick in his face, but the shark is thwarted and seeks less intimidating prey. To remain motionless, like a corpse, might actually present the sign stimuli for shark attack under some conditions. I would caution that what applies to the submerged diver does not necessarily apply to a surface swimmer. Not many years ago some of my colleagues found that certain shark species could be attracted by playing pulsed, low-frequency sounds in the same frequency range as noises recorded from a thrashing swimmer!

The book is interesting and praiseworthy but open to several criticisms in my opinion. I feel the discussions of apartheid (in the section on the whaling off South Africa) and the personal and moral questions raised by Matthiessen are inappropriate in this book. They are irrelevant and distract one's attention from the main focus of the story. The same criticism can be leveled at the discussion of whaling, where we learn, if we were not already aware, that whales are being harvested to extinction. Although the author makes the point well and gives us insight into the whalers' points of view, this is, again, distracting and would not be missed. Perhaps we all should be distracted from less consequential trains of thought by the perversions that are apartheid and over-exploitation, but they are subjects deserving of separate treatment.

There are few editing errors and the scientific content is generally accurate. However, I am still puzzled that a great white shark caught off Montauk, Long Island, some years ago had a belly full of periwinkles. It is hard to imagine a great white browsing the subtidal rocks for tiny gastropods.

However, the faults are greatly outweighed by the over-all quality of this book. I recommend it to divers and naturalists alike, and to all who wish the vicarious thrills such adventure can provide.

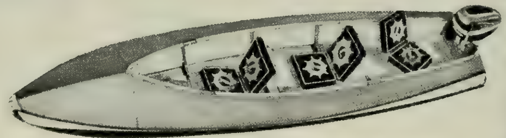
Dr. Herrnkind, assistant professor of biology at Florida State University, has dived in the line of research since 1961. He was a scientist-aquanaut in the Tektite-2 undersea habitat research program in the Virgin Islands.

More Reviews

THE SECRET LIFE OF THE FORES
Richard M. Ketchum. *American*
tage Press, $7.95; 111 pp., illus.

With no table of contents, no i
chapters, or bibliography,
work barely qualifies as a book
tually it is an expanded versi
corporate-image advertisements
by the St. Regis Paper Compa
recent years.

The author is not a profess
naturalist, but the manager o
publisher's book division. Appa
he decided that the generall
cellent illustrations by Jack
were still salable, so he contri
text to weld the pictures tog
The result is grossly inaccurate,



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ally trivial, and often banal. Scientific worth aside, it isn't even "one of the best-written" books of the year as the jacket promises. Although he is usually just tedious, Ketchum can rise to the occasion with constructions like: "Which brings us to what the objectives of the forester are. There is no question but what. . . :" The reader's suspicion that he is conversing with someone totally inadequate is heightened when he is told that trees have no lungs, photosynthesis is a magical trick, a germinating seedling pushes with two legs instead of one, each cell is like a little bubble, and the trunk of a tree holds itself erect by means of the bulging cells inside its skin.

Ketchum's understanding of evolutionary processes is on a par with his knowledge of tree physiology. He is plainly partisan in the "evolutionary struggle" between the flowering angiospermous trees ("culmination of plant life on earth," "orderly," "sophisticated") and the gymnosperms ("haphazard," "chancy," "profligate"). One hesitates to attack his ideology—after all, what else has he? Facts? Hardly. But consider some of his non-facts: conifers furnish no food for man or beast, roots absorb food, a seedling's terminal bud is below its leaves, seeds develop from flowers, high temperatures are not injurious to plants—one can catalog these incredible statements indefinitely. Surely Ketchum has invented the most stupendous non-facts in recent publishing history. He tells us that 55 leaf illustrations represent almost all the tree genera of North America; but there are over 250 genera in North America, excluding Mexico.

It is insulting to the specialist and contemptuous of the novice to pretend, as American Heritage seems to, that pretty pictures can be magically transformed into popular scientific literature by an ignorant writer. This is the Age of Aquarius and the Era of Ecology, and the hucksters are out there in the marketplace with their meretricious "potboilers." *Caveat emptor!*

RONALD M. LANNER
Utah State University

Briefly Noted:

TREE TRAILS IN CENTRAL PARK, by M.M. Graff. *Greensward Foundation, $3.95; 189 pp., illus.*

A group of tours to the trees of Central Park is deftly combined with the history and philosophy of the park as outlined by its creators, Frederick Law Olmsted and Calvert Vaux. Eleven detailed walking tours acquaint the city dweller with the rich variety of trees and shrubs in the par
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will not only be able to identify a
variety of trees but will also pic
a recipe for ginkgo nuts, lea
recognize the difference between
and bad tree pruning, and be
painfully aware of recent an
conceived additions to the park.
book, handsomely illustrated
Jacques Hnizdovsky, can be or
from Friends of Central Park, I
Hill P.O. Box 610, New York,
York.

AUTOKIND VS. MANKIND, by Ke
R. Schneider, *W. W. Norton &*
pany, $7.95; 267 pp., illus.

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automobile, Kenneth R. Sch
zeroes in on the auto's most i
ous vice: its alteration of urba
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onslaught of the automobile's de
for freeways, wide streets,
circles, and parking spaces. Th
thor offers a number of suggestio
how mankind can reclaim its
eignty from autokind, and illus
Richard D. Hedman provides
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KITES, by Wyatt Brummitt. G
Press, $1.25; 120 pp., illus.

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everything you would want to
about kites, including their fo
and colorful history. The constr
and aerodynamics of almost
possible style and shape of ki
considered, as are the elaborate
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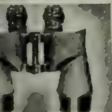

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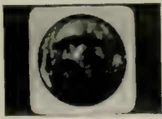

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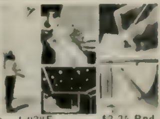

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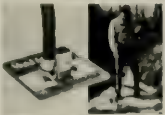

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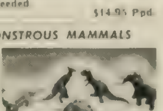

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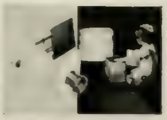

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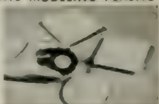

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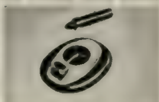

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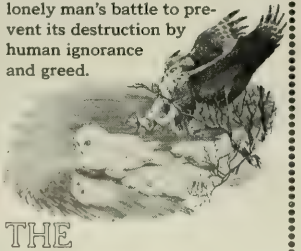

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EXTINCT AND VANISHING ANIMALS. V. Ziswiler. Springer-Verlag Inc., New York, 1967.

BEFORE NATURE DIES. J. Dorst. Houghton Mifflin Co., Boston, 1970.

BIOLOGICAL CONSERVATION. D.W. Ehrenfeld. Holt, Rinehart and Winston, Inc., New York, 1970.

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THE ABYSS. C.P. Idyll. Thoma
Crowell Co., New York, 1964.

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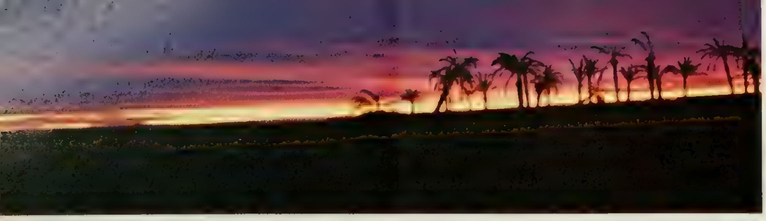

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INCORPORATING NATURE MAGAZINE

The Journal of The American Museum of Natural History

Vol. LXXX, No. 6 June-July 1971

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With the help of an old Yaqui Indian, some devil's weed, and certain innate qualities of your own, you too might be able to fly off into the night.

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COVER: *By the light of early morning, Zulu Zionists gather to purify themselves in the waters of the Indian Ocean.*

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e's a saying:

od must be a Brazilian. Of course it is just a saying. But after you've toured
l with us you may not be too inclined to argue the point. Because you'll be remembering the pano-
of Rio as seen from the statue of Christ the Redeemer whose outstretched arms seem to embrace
ewel of a city. Its harbors, its hills, its beautiful bays and sweeping beaches. You'll remember
ing to Rio's bossa nova heart beat at night and on into an unforgettable dawn. And of course the
ocas—the people of Rio—will have given you your most precious souvenirs . . . gifts of kindness,
ffection and just plain fun. From Rio, take a short side trip to Congonhas where stands the statues
twelve apostles carved by a man who had his mallet and chisel strapped to his wrists, because
d no hands, and whose work is compared to that of Michelangelo. You'll marvel at Brasilia a
modern world of tomorrow wrought from a wilderness. You'll also have stood in awe and rever-
before the might and majesty of Iguassu Falls—higher than Niagara—whose roar can be heard
y miles away. Is God a Brazilian? Let's not argue the point . . . at least until you return. Varig
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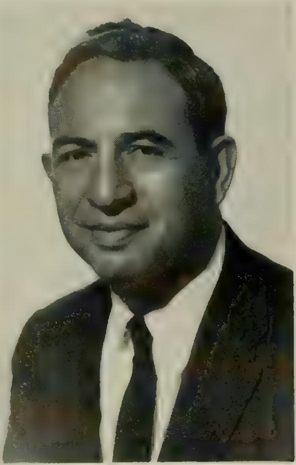
Authors

The whimsical essay "A Dissertation on the Beaver" is excerpted from *The Great Fur Opera: Annals of the Hudson's Bay Company 1670-1770.* The author, **Kildare Dobbs,** was born in Meerut, India, and educated at Cambridge and London Universities. He spent four years in the Royal Navy, was appointed to the Educational Service of the Tanganyika government, and became headmaster of the Old Mosci School on Kilimanjaro. Dobbs, now a resident of Toronto, went to Canada in 1952. He is a regular contributor to Canadian Broadcasting Company public affairs programs. These provide him with a platform from which he can expound upon such diverse subjects as the latest missile projects, ancient history, hippies, jazz, gamesmanship, and Marshall McLuhan.

Ronald Searle's first cartoons were published while he was a schoolboy. Seven years' service with the Royal Engineers, three and a half spent as a Japanese prisoner, failed to dim either his energy or sense of humor. The drawings he made of his experiences helped to establish his reputation, and in 1947 he began to draw for *Punch.* He has also acted as a pictorial reporter for *Life* magazine, covering the Eichmann trial and John F. Kennedy's election campaign. Between his travels, Searle collaborated on many books, produced a number of albums of his own drawings, and created the animation sequences in the films *Those Magnificent Men in Their Flying Machines* and *Those Magnificent Men in Their Jaunty Jalopies.* Born in Cambridge, England, Searle has lived in Paris since 1961. He continues to contribute to many magazines in France, Germany, and America, and his work has been exhibited in New York, London, Germany, France, and Belgium.

His discovery of a chemical substance that increases soybean yields brought **Arthur W. Galston** up against an increasingly relevant question: is a scientist responsible for the uses made of his discoveries? Galston believes that his early investigations helped researchers at the chemical warfare laboratories at Fort Detrick to velop defoliants. As a result, he put in long hours trying to vince his fellow scientists of need for more responsiveness to cial problems. Galston, who tained his doctorate in botany f the University of Illinois, is a fessor of biology at Yale Univer In May, he was one of the first American scientists to visit C since the recent improvement o lations with that country.



While studying the processe political development among dians. **Keith L. Pearson** be aware that their adoption of vogues as "click-clacks" and skirts indicated cultural ada ness, not merely assimilation. result of his involvement with Indians and their urgent prob of poverty and cultural identit became a community develop trainer with the Indian Comm Action Project. Now assistant fessor of anthropology at Nor Arizona University, Pearson to study Indian community opment processes in reserv and urban settings. He earn Ph.D. in anthropology from University of Arizona. His *The American Indians: Their tory and Cultures,* will be publ this fall.

In 1923, **F. G. Marcham,** t young graduate student recent rived from England, met Agassiz Fuertes at a Thanks Day party. A friendship soon oped. After Fuertes's death

ghter became one of Marcham's
ents, and this gave him an op-
unity to examine in detail the
y paintings still in the artist's
io. Marcham is professor emer-
of English history at Cornell
ersity, where he received his

. in modern history. His book
; *Agassiz Fuertes & the Sin-*
Beauty of Birds will be pub-
l by Harper & Row in October,
.

nes W. Fernandez speaks
reads Zulu, and has studied a
of Zionism in South Africa.
accomplishments are an out-
h of his many field trips to
countries as Gabon, where he
d a Fang syncretist cult, and
mey, Togo, and Ghana, where

earched culture change in the
dza peoples. His work has
ivolved ethnohistoric research
ain, Germany, and France.
ndez, professor of anthro-
at Dartmouth, obtained a
in cultural anthropology
Northwestern University.

For **Fred Bruemmer**, the six-hour trip to Funk Island by fishing boat was an experience in how to get seasick, but he feels the photographs he obtained of the island's birds made it worthwhile. Born in Riga, Latvia, and now a Canadian resident, Bruemmer is a freelance writer and photographer. He spends six months of the year in the Arctic observing the region's peoples and animals and has traveled extensively with the Eskimos via dog sled. Bruemmer's previous publications in NATURAL HISTORY MAGAZINE include "Sable Island," August-September, 1967; "Ill Shapen Beast," March, 1968, and "A Day in the Life of a Polar Bear," October, 1968.

After six summers of probing the biology and behavior of snapping turtles, **Donald A. Hammer** continues to learn more about these aquatic reptiles with the mean reputation. He is currently analyzing data on the effects of snappers on a marsh's waterfowl productivity. His previous field work has included studies of mink movements, waterfowl censuses, and banding projects. Hammer, whose plans include the application of systems analysis to the study of vertebrate population dynamics, is presently a doctoral candidate in ecology at Utah State University.

Searching for the whereabouts of the Upper Ordovician South Pole of some 450 million years ago was one of the more dramatic studies undertaken by **Rhodes W. Fairbridge**, who has made a number of discoveries in the fields of paleoclimatology, geomorphology, geosynclines, and world geotectonics.

His studies of the gravitational processes of sedimentation and tectonics, littoral sedimentation, and changes of sea level have taken him to the Middle East, the South Pacific, Czechoslovakia, Egypt, the Sudan, Brazil, Yugoslavia, Cambodia, Hungary, France, New Guinea, and Algeria. Fairbridge, born in Pinjarra, Australia, received a D.Sc. in geology from the University of Western Australia and is professor of geology at Columbia University. He will serve on an international commission in Sweden this summer to determine the lower boundary of the Holocene epoch.

Letters

A Wolf Inside the Church Door

Thank you for making it possible for me to have the wolf record. The record has arrived safely and will be a great help in our ecology oriented church service.

Garland Riggs
Prince Georges, Maryland

May I be one of the first to say you are going to get repercussions from the wolf record. I played it and had two very bristly cats stalking around the house. So my fiendish mind got to wondering what would happen if I put my remote speaker out in the backyard and turned it on some late evening. We've had a pack of stray dogs roaming the neighborhood, so all the people are a little sensitive about dogs. I'll bet we could have a panic if I played that record!

And then—one thing leads to another, of course—I got to thinking what you could do with it in a remote campground!

I'm sure there are more mischievous minds than mine around, so who knows what will happen?

I hope it isn't too bad, and I do enjoy having the record, especially with the magazine article to go with it. But for the cats' sake, I won't play it often.

Jackie Cobo
Ashland, Oregon

The Psychology of the Hunter

In reviewing *Death As a Way of Life*, by Roger A. Caras, Gerald Carson deftly and tellingly presents the viscerotonic position. Unfortunately for his case, two-thirds of the human race are not viscerotonics. Somatotonics and cerebrotonics are equally valid members of *Homo sapiens*, and they have completely different aims in life, with different values to match.

I am a hunter, a zoologist (A.B., University of California, 1930), and a psychoanalyst (nonmedical). I deplore as much as anyone the insensate decimation of other species. I also perceive that man is a predatory carnivore, among other things.

I assume that Mr. Carson is a vegetarian. If he is not, two minutes in a slaughterhouse would make him one. I'm just cerebrotonic enough to be a bit squeamish at watching a steer knocked in the head, but never in my life have I felt any inclination to quit eating steak. I'm somatotonic enough to be quite willing to bring down a buck with a well-placed bullet of my own loading, cut his jugular with a keen blade of my own fashioning, and chop down his backbone with an ax to produce the tasty venison that will feed my family.

If this be brutality, let Mr. Carson make the most of it, for man *is* a brute.

Being a hunter does not prevent me from being an avid bird watcher, a photographer of native flora (7,000 Kodachromes in habitat), and a member of all the conservation societies I can afford. Nor does it prevent me from being one of Mr. Carson's "great majority of Americans who cherish our native game animals as an esthetic or spiritual experience." No hunter worthy of the name, whether primitive or civilized, is anything but grateful to the game for being there, for being fascinating to watch, and for bringing him into intimate relation with all of nature's wonderful world.

I am a member of The American Museum of Natural History, and have been for many years. I am also a member (life) of the National Rifle Association of America. And I support the aims and programs of both.

Brooking Parsons Tatum
Palo Alto, California

Switching Off a Crisis

I hope that letters from people such as Foster A. Haley (April, 1971) will not deter you from doing the fine job that you have been doing in selecting articles for the magazine.

One wonders about words of caution, such as those of Mr. Haley. Does he really understand the absolute requirement that we learn of the webs of ecosystems in which we live?

Who are the "we" who are "getting pretty tired of reading about it"? Is the environmental crisis something that can be turned off like the radio or TV?

Edward Schriver
Orono, Maine

Correspondent Foster A. Haley, Alabama subscriber, member, and admirer of Natural History, writes that he's "pretty tired of reading about" a good environment and a able ecology.

I have a question.

If Mr. Haley were sitting in easy chair in a tent and some go neighbor rushed in to say, "Hey, H ley, the hurricane is half a mile aw you'd better dive into your cella would Mr. Haley say, "That's fourth time you've warned me— away while I finish reading Natu History"?

John B. Wentwor
Washington, I

(Footnote: a tent with a cellar!?!)
(Footnote #2: Well, if it's hurric country, why not?)

Advertising and Environment

How about making a more " logically sound" periodical by pr ing all full-page ads (and group ads to fill pages) so that these co be torn out and the paper recycl This way, people who save their issues would be saving less bulk not accumulating the unessential terial, which could be reused.

Kaaren J. Klin
Ann Arbor, Michi

I have been a subscriber now Natural History Magazine for two years and I am generally lighted with the high quality of publication. However, I wish to test most strongly the publication an advertisement on behalf of Ecological Food Society. This ad tisement contains a number of st ments, having little foundation in entific fact, that are calculated mislead and frighten an already prehensive public.

Publication of this advertisen in Natural History automatic lends it some authority, and I t you should seriously consider whe you intend to do this.

Environmental pollution is of g concern to us all, but professional entists should try to keep the pro in perspective. As you are well aw there are a considerable numbe scientists who feel that the conti use of many of the better agricult chemicals is not only desirable imperative if we are to feed the p lation of the world.

Bryan True
Auburn, Alab

hat did we learn from building the moon camera?

earned what a good camera
ady had on earth.
use the moon Hasselblad is
ly our electrically-driven
lad 500 EL.
also learned that NASA's
aphic needs were much the
s the needs of serious pho-
ers anywhere.
needed to bring back high-
ion photographs. (Don't
The Hasselblad 500 EL
the superb optics of Carl
enses, plus the large 2¼"
ormat.
needed great shooting ca-
(Haven't *you* been in spots
ou wish you'd had more
your camera? Or could
from black and white to
mid-roll?) The 500 EL, with
changeable backs, offered a
apacity magazine. Which
hat no film would have to
d by the astronauts during
e moon walk. A fresh, pre-
ack could be snapped on
as needed. In a matter of seconds.

NASA needed simplicity of operation. (Aren't there times when you, too, want to concentrate on your subject, not your equipment?) The 500 EL offered electrically-driven automatic film advance and cocking of shutter.

Most of all NASA needed fail-safe reliability. (After all, if *you* were going on a long trip and didn't know when you'd get there again, you'd want insurance, too.) Hasselblad had been the space camera since 1962, so there was no doubt that it would perform reliably on the moon.

There are, of course, some differences between the moon and earth Hasselblads.

For one thing, the moon Hasselblad has wings on the diaphragm and shutter speed rings so they can be operated with bulky gloves on.

It has an oversized shutter release button for the same reason.

And a longer handle on the magazine slide for the same reason again.

And a safety lock to prevent the film back from floating off into space during weightlessness.

The earth Hasselblad doesn't have any of these things because it doesn't need them.

On the other hand the earth Hasselblad has things the moon Hasselblad doesn't have. Or need. Like interchangeable film transport mechanisms, three focusing screens and viewers.

In its own way, the earth Hasselblad, with its reflex viewing system, is just as sophisticated as the moon Hasselblad. So rather than stand in awe of the astronauts' Hasselblad, it would be equally appropriate for the astronauts to stand in awe of *your* Hasselblad.

If you don't require an electrically-driven film advance, there are other Hasselblad bodies. All part of the Hasselblad system which includes three basic cameras, ten interchangeable Carl Zeiss lenses ranging from 40 to 500mm, five interchangeable magazines from 12 to 70 exposures, interchangeable viewfinders plus a large number of specialized accessories.

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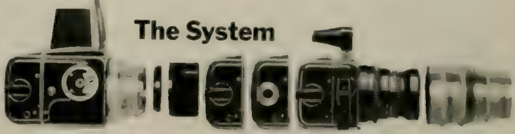

The System

a Dissertation on the Beaver

K. Dobbs Esquire
Scribbler

R. Searle Esq.r
sketcher

"A traditional knowledge of the beaver," says a Victorian authority, "is the birthright of every Canadian."

And not only of every Canadian, since the castor, or beaver, exists in two species, of which one is European and has been known since antiquity.

Consider, then, this exemplary rodent.

The name castor (with Pollux one of the Heavenly Twins of classical myth) springs, perhaps, from the same root as the Latin *castra*, a camp or fortified place, from the creature's marvelous skill in defensive engineering; though some authors derive it from the Greek word for stomach, since its earliest uses, as Hippocrates testifies, were medicinal. The name beaver has a clearer etymology. *Fiber* or *fibir* seems to have been his Latin name; in German *Biber*. The connection with drinking (*cf.* Spanish *beber*, and the English word *beverage*) is obvious.

From earliest times the beaver was renowned for sagacity. His wise foresight in building dams and canals to provide his lodges with underwater approaches could only excite awe and admiration. But these achievements, amazing as they are, are not among those cited by Pliny the Elder as illustrating his cleverness.

What Pliny does report is more remarkable still: that the beaver, hunted for castoreum, a precious medicine contained in his testes, would tear them off (*cf.* English *castrate*) and leave them for his pursuers, escaping with what was yet more precious—his life. Thus the beaver became the Emblem of Prudent Sacrifice.

Castoreum was a nostrum for mental sickness. "Castoreum for the brain," as Sir Francis Bacon puts it. The author of *Castoris animalis naturam et usum medico-chemicum* (1685) recommends castoreum for earache, deafness, gout, and headaches, noting that it "does much good to mad people. It destroys fleas, stops headaches and induces sleep." Other parts of the beaver were of great utility in colic, madness, spasms, epilepsy, apoplexy, and lethargy.

Castoreum had other uses. In time it was found to be an irresistible bait for beaver traps. In 1673 a paper was published in London on "The art of driving away and si
ing Whales by Castoreum."

But broadly speaking, this
sence of the prudent beaver
thought to confer a like prude
on its consumer. The principle i
familiar one in sympathetic ma
Nor can we ignore the significa
of beaver-fur's coming into use a
material for hats—in effect, the
ternal application of beaver to
brain.

The point—hitherto overloo
by scholars—is supported by a J
ish tradition that the use of a b
ver hat was the secret of Solomc
wisdom. His prescription: "To
quire a prodigious memory
never to forget what he had
read, it was only necessary to w
a hat of the beaver's skin, to
the head and spine every mo
with that animal's oil, and to t
once a year, the weight of a g
crown-piece of castoreum."

That the beaver's soft unde
or down is barbed in a way
makes it peculiarly well adapted
manufacturing felt is not, of cou
to be overlooked. Yet felt is
used for making boots, and ther
no record of beaver-felts being
plied successfully in that way.

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balance. it becomes clear that beaver hat is magical in origin.

Pliny's story found its way i the medieval bestiaries. Monk scholiasts must have been str with its parable of celibacy. At events it became common kno edge. Early Committee members the Hudson's Bay Company co well, with their classical schooli have read it in the original. It them with a misapprehension as the true source of castoreum. T were forever urging their serva to trade "Beaver codds" or "g dering stones."

By the eighteenth century m information had been colle about the beaver. He had beco widely known as a tireless wo cutter, the Emblem of Diligence.

Buffon, the great French natu ist, looked at him carefully f the front and observed: "If we c sider the anterior parts, no ani is more perfectly adapted for restrial life." Then, turning round to inspect the other end, added: "And none so well equip for an aquatic existence, if we l only at the posterior portions."

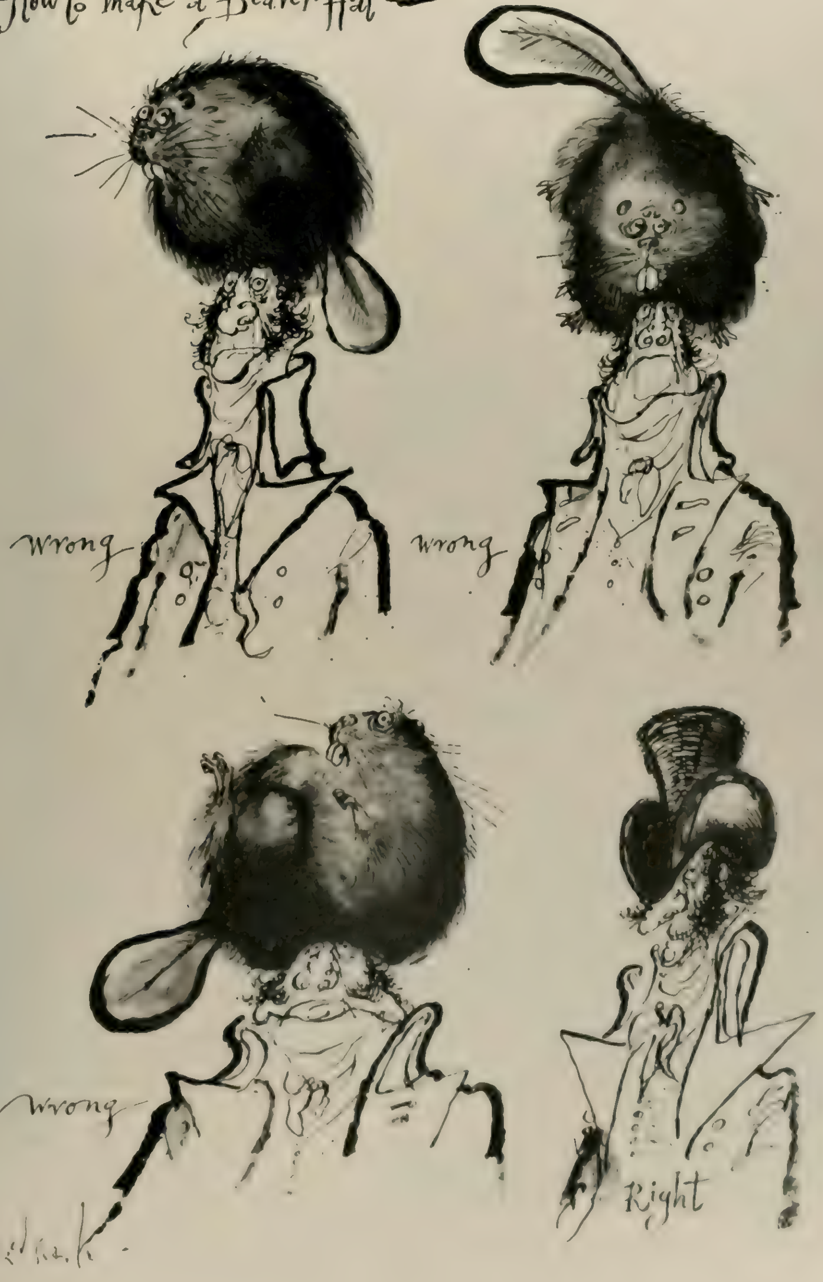
From this viewpoint, it was found that the wide, flat tail w delicacy. In 1860, no less a vis than the Earl of Southesk nounced it palatable. He was reluctant to name it, referring tidiously to "the last joints o beaver's backbone."

By the 1750's, when Mala Postlethwayt was adapting his *U versal Dictionary of Trade Commerce* from its French origi beaver science was far advan Beavers, he reported, fed only fish. "In the spring, all those of same district, or quarter, gather gether, and, walking two and they go in a body to hunt for mals of their own species; and those they can catch they lead their dens, where they make t work like slaves." These, howe were Russian beavers.

Russian, too, were the felt-ma who knew a way to comb the un coat of wool or down from a ver-pelt without removing the guard hairs. It was only neces to remove the beaver.

Lacking this secret till the teenth century, English and Fr hatters at first preferred to their beaver in coat. Worn by

How to make a Beaver Hat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dians till it was ripe, *castor gras* coat-beaver had already shed guard hairs. The glossy underw was ready for removal and use felt. Trunk-covers and slippers we made from the skin.

"The process of hat-making," c serves wise Postlethwayt, "may pear insipid to those who do not e ter into the public utility bringing every manufactured to its last perfection." The hat first makes a cone of felt, th bashes it into shape.

Felt is simply matted hair. B ver fur, because its hairs barbed and hook together, mats m tightly than other kinds.

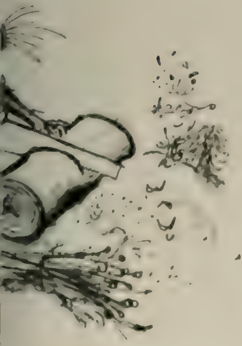
Beaver hats stayed in fashion long periods. More or less pensive, they were always dural Fine beavers with furry nap w flaunted by the French. W smooth, they were stiffened w gum and sold to the Spanish. T *caballeros* in time passed them to the Portuguese, who rem them in smaller sizes for sale

il. Thence the thrifty Portu-
e recovered them, full of holes,
ale in Africa.

ritish postmen were first uni-
ed in 1793. their issue hat a
beaver. It lasted them till 1859.
e beaver hat persisted into the
nineteenth century as a head-
for cricketers, who used it to
orm the Hat Trick. (Putting a
er into the hat, instead of tak-
rabbit out of it.)

t for elegant wear, the beaver
on its way out. John Hethering-
had made his first top hat of
or silk shag in 1798. By 1851,
ear of London's Great Exhibi-
English production of silk hats
booming at the rate of 250,000
r.

e Committee was already plan-
a revolutionary new use for
er. In 1843, Secretary Archi-
Barclay had written a note
t it: "We have been trying
experiments on Beaver, with
iew of testing the fitness of the
le to be used as a fur. . . ." ■



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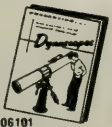

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A Naturalist at Large

Education of a Scientific Innoce

Visitors to the traditional Christmas meetings of t
American Association for the Advancement of Scier
have, over the last several years, been treated to the sp
tacle of open demonstrations and widespread disaffecti
voiced by students and young scientists against organiz
science, and specifically the scientific establishment of t
AAAS. What was the nature of these complaints, voic
not only by members of the radical left "turned off"
modern America but also by establishment-minded, s
ence-oriented students preparing for careers in the fiel
Science, they complain, is not being used in construct
ways in our society, but rather for antisocial, frequen
destructive ends. It has too often been a captive of t
military–industrial complex, its discoveries being utiliz
to advance weapons technology or to produce new, e
pensive gimmicks that an already financially ov
burdened public is then induced, against its own bet
interests, to buy. Modern science, the indictment cont
ues, does not serve the needs of the people, rather it co
tributes to man's exploitation by man, leads to accelerat
fouling of the environment, and diverts resources fro
more important social problems. One typical target is t
space program and its expenditure of several billions
dollars, which its critics point out could better be appl
to the amelioration of housing in our slums or the u
grading of our deplorable transportation systems. T
many scientists, say the young dissidents, have not s
ficiently concerned themselves with what happens to th
discoveries once they have been brought into the pub
domain. Social responsibility, they add, is deplora
lacking in scientific circles.

The response of the scientific establishment has be
mostly defensive, for the criticisms of the young seem
too close to the mark to ignore. The young radicals a
their supporters have therefore been given time and sp
at the scientific meetings to present their view of the

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by Arthur W. Galston

of science and of the social responsibility of the sci- st. Not content with this small piece of the action, the dents have frequently marched unannounced into ses- s at which distinguished scientists and public servants : been scheduled to speak and have disrupted the tings in such a way as to cause a subversion of their nal intent or, in fact, their cancellation. The most nt example of this was the prevention, at the Chicago ing of the AAAS, of the scheduled speech by the nization's newly elected president, the distinguished nist and Nobel Laureate, Dr. Glenn T. Seaborg. Sea- also happens to be chairman of the Atomic Energy mission, which has been coming under increasing at- by radicals and some liberals, not only for its relaxed ·y concerning permissible "safe" levels of atomic radi- ı but also because it has been charged with suppress- lemocratic dissent against these policies, expressed by distinguished members of the Livermore, California, . Drs. John Gofman and Arthur Tamplin.

is understandable that the main objects of the brick- have been physicists, chemists, and engineers, whose ion to military weaponry and devices or products that up the environment is too obvious to need comment But recently the biologists too have come in for their : of criticism, for as biology moves more and more into nolecular realm, as biologists become increasingly able ›ntrol processes that they could only distantly describe al years ago, their labors become increasingly adapt- to application or, it must be added, misapplication ›ciety.

the years since the Second World War, scientists shown an increasing response to the social problems rated by, or affected by, science. The AAAS, which over a hundred thousand members, is generally con- ed a very conservative and "fat cat" type of organiza- but under prodding from some of its more socially

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minded members, directors, and critics, it has seen fi establish several active committees dealing with sci and the promotion of human welfare. Increasingly, meetings are dominated by socially relevant progra The Federation of American Scientists (FAS), a m smaller organization of avowedly socially responsible entists, was formed immediately after the Second W War, largely by physicists and chemists who had b members of the Manhattan Project, which gave rise to atomic bombs that devastated Hiroshima and Nagas Over the years this organization, which first fought cessfully for the civilian control of atomic energy, concerned itself with major problems in which its m bers felt organized science had a stake and should pre a socially relevant point of view. Recently they have voted their efforts to such questions as antiballistic siles, MIRV (multiple individually targetable re-entry hicle), the SST (supersonic transport), and chemical biological warfare. A still smaller group, the Society Social Responsibility in Science (SSRS), was organ several decades ago, largely around a group of pac scientists who felt that no member should engage in w that contributed in any way to man's potential to w warfare. Although the American group has tried to international in scope, a British group has recently b formed with a somewhat different orientation. Whethe not the social orientation of scientists and the social r vance of science will continue to permeate scientific de erations in the future is not known, but in view of increasingly sharp crises posed by technological advan many feel that such a trend is inevitable.

Scientists are often criticized for doing any work tha any way contributes to military weaponry or that in way becomes subverted to antisocial uses. Why, the yo want to know, don't scientists simply abstain from do anything that could possibly be misused and turned counterproductive programs? The answer is, of course older scientists try to explain, that scientific discove are by themselves neither necessarily good nor bad society. Einstein's discovery of the interconvertibility matter and energy was ethically neutral. Its use by soc for the generation of power through nuclear reac could be socially beneficial, while its use to detonate atomic bomb is obviously socially destructive. In short abstain from working on subjects that might be used any destructive way would mean to cease all scien effort. Not only is this impractical, but it would prob be absolutely catastrophic for the future of mank With our increasing population and decreasing resour we must live increasingly by our wits; in this effort application of the newer scientific and technological in mation is absolutely essential for survival.

Perhaps a personal account would help to illumi the quandary in which many scientists find themsel During my graduate work on the interface between any and chemistry, I became interested in the poss chemical regulation of the reproductive habit of pla As I described in a previous article, many plants are duced to flower by the appropriate length of day, and

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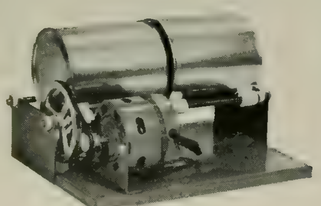

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evidence at hand strongly suggests that the appropria day length causes the synthesis in the leaves of a reprodu tive hormone, which then migrates to the bud. I notic that in the soybean plant (which is economically impo tant in the state of Illinois where I did the work) th onset of reproductive activity was accompanied by a d crease in the plant's vegetative growth. I reasoned that if could find a substance that would slow down vegetati growth, I might promote the tendency to form more flow ers, which would lead to more soybean pods and a bigg harvest. I decided to try to find a substance that woul function as an antigrowth hormone, and would thus an tagonize the tendency to vegetative growth. I was succes ful in this quest, and in my Ph.D. thesis reported that th chemical substance known as 2,3,5-triiodobenzic ac (TIBA), when applied to soybeans growing under appr priate conditions, could greatly increase the number flowers formed. Many years later, and unbeknownst me, this basic finding was patented by the Internation Minerals and Chemical Company of Illinois, and substa tial quantities of TIBA are now being sold to increa soybean yields in the more northerly reaches of this crop agricultural range.

Anyone hearing this part of the story would conclu that my discovery of the flower-promoting action of TIB was a socially constructive act. Yet there were subtle an unforeseen corollaries to my discovery that, many yea later, caused me some embarrassing moments. For TIBA is used at somewhat higher concentrations than had used, it produces side effects, including the sheddi of buds and even of leaves from the plants. This proce known to botanists as abscission, can be very importa in the control of plants for both productive and destru tive objectives. In cotton fields, for example, where m chanical harvesters are now used in preference to han labor, it is constructive and desirable to spray a defolia over the plants and free the plant of unwanted leav before the mechanical harvester goes through the field collect the bolls. But recently, as Americans have come know, massive quantities of chemical defoliants have be used over the forests and farms of Vietnam for destructi purposes [*see* "Ecocide in Indochina," NATURAL H TORY MAGAZINE, March, 1971]. I have some reason believe that my early investigations on TIBA helped se eral researchers at the chemical warfare laboratories Fort Detrick in their design and understanding of t defoliating action of chemicals of the plant hormone ty Thus, confronted by the spectacle of the misuse of discovery, I found myself, several years ago, forced into protest against this misuse and into a growing involveme in the social relevance of my own scientific effort. It pears that my life will never again be as simple or placid as it was before.

My investigations revealed that in the years since 19 American military forces have sprayed more than 1 million pounds of assorted chemicals over more than million acres of South Vietnam. Substantial percenta of the hardwood forests of that country have been verely damaged, with great potential economic loss to

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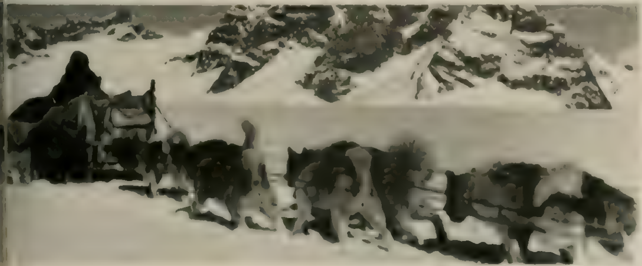

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lumbering industry of South Vietnam, one of the majo sources of potential export trade. Certain important ecological niches, such as the mangroves lining the estuarie near Saigon, have been permanently killed, perhaps neve to recover. Crops feeding more than half a million peopl per year have been destroyed, causing a great upset in th lives of many innocent noncombatants, including th Montagnards. When I first became aware of the extent o this program, I wrote a letter to President Johnson askin him whether he understood the broad implications of th use of chemical weaponry. He replied, through an assis ant secretary of state, that these weapons were being use on the advice of qualified scientists, that they produced n effects deleterious to humans, animals, or to the ecolog and that in any event they were the same chemicals th were being used at home in agriculture, so that their us could not be criticized. Aware that there was no reall adequate scientific basis for these conclusions, I tried t involve several botanical societies in raising questions t the government, but at that time my efforts were completely unsuccessful. Later, thanks to several determine and dedicated individuals, pressure was put on th AAAS, the FAS, SSRS, and other organizations. Som raised their voices, the AAAS sponsored an investigatio and gradually the entire nature of our defoliation ope ations in Vietnam has been revealed to the public. So il advised does our chemical warfare in Vietnam now see that President Nixon has recently announced that all suc operations will be phased out some time in the sprin when existing stocks of the chemicals are gone. He als has announced that he will submit to the Congress a pro posal that we ratify the Geneva Protocol of 1925 forbid ding the use in warfare of "asphyxiating, poisonous o other gases, and all analogous liquids, materials or de vices." The additional revelation that one of the maj herbicides employed in Vietnam, 2,4,5-trichloroph noxyacetic acid (2,4,5-T), either by itself or by virtue o an impurity it contains, can produce malformation of d veloping embryos in laboratory animals and possibly i humans, has led to curtailment of this product in th United States and a frantic crash program to discov whether, in fact, the chemical can ever again be use safely.

So, even a botanist, one of the last of the scientif innocents, can be involved in problems permeating eve aspect of society. Many scientists are now coming to fe that they cannot surrender control of their findings businessmen, politicians, or others for indiscriminate a unregulated use in social or military contexts. More a more, the scientist wants to concern himself with the s cial consequences of his discoveries. To do this he is r shaping his organizations, forming new groups, and maki frequent journeys to Washington to convince legislato and government officials of the necessity of altering u wise policies. Social relevance is here to stay, and scien will never be the same again. The universities, whi should be training the scientists of tomorrow, are on slowly beginning to recognize their new and enlarged r sponsibilities.

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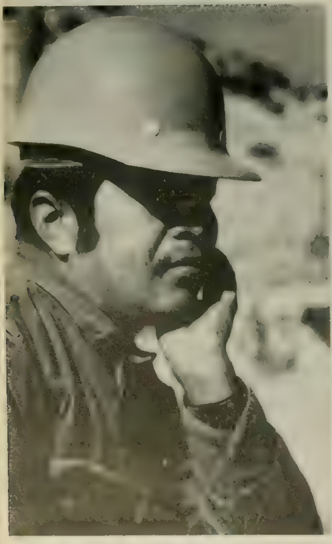


"WATCH OUT, YOU MIGHT ASSIMILATE"

Conquerors have ruled them for centuries, but the Pueblo Indians have maintained their distinctive culture. Can they survive the problems and temptations of a modern age?

by Keith L. Pearson

In front of a wind-worn adobe all two Indian boys try out heir newly bought "click-clacks." nd the sharp tat-tat-tat of plastic alls smacking together proof of ieir growing proficiency echoes irough the Santa Clara pueblo. A iiniskirted young woman pauses in ie street to watch the boys practice. red pickup truck pulls up, and the iver blows the horn, adding more oise. At all age levels, the 10,000 ueblo Indians living in the Rio rande region, including the resients of Santa Clara, glaringly reeal their assimilation into the esent-day culture of the United ates.

A casual observer such as a dispointed tourist seeing that these dians had abandoned most of eir heritage, would predict that y remnants of the Pueblo Indian culture will be gone in a few years. But such a pessimistic prognosis would be wrong. The Pueblo Indians have prevailed as a cultural entity for thousands of years, they possess a strong cultural structure today, and I believe they will maintain their identity for generations to come. This can be seen by looking at the people, their history, and their handling of contemporary problems, rather than by focusing solely on their architecture and public ceremonies.

The Pueblo people have consistently constructed societies capable of successful adaptation to severe ecological and environmental changes. They are dynamic, not helpless; they are creators, not simply the pawns of other societies.

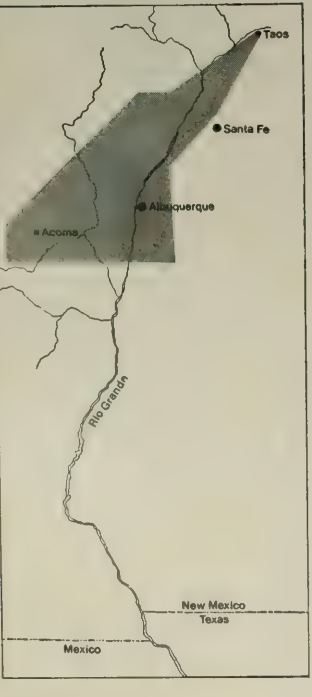
The prehistoric and historic records attest to this view. About one thousand years ago there was a severe and prolonged drought in the southwestern United States, causing dramatic changes in the life-styles of the area's peoples, including several groups that were ancestors of the Pueblo Indians. Along the Rio Grande, groups of people using irrigation systems for their farms began to settle in the region. They are known as the Tanoans, a name derived from their language. Their irrigation systems, complicated networks of canals, dams, and floodgates insured the success of their crops even during droughts.

The people who built these irrigation systems had also developed a social organization that could mobilize workers for canal construction, maintenance and repairs. They had devised communal [illegible] ods for making public decisions about land use and planting as well as water control.

Archeologists consider the Tanoans to have been the earliest permanent village, or pueblo, residents of the area. They were not, of course, the only people who made use of the riverine resource. From time to time, hunting bands camped along the waterways, and other groups entered the region for trade purposes. The Tanoans undoubtedly interacted with the hunting and trading groups, exchanging ideas as well as material goods.

During the fourteenth century, another group of pueblo people appeared in the Rio Grande region. These people, who spoke a language known as Keresan, farmed without irrigation systems. Their social organization emphasized kinship alignments instead of political leadership. Their view of the world stressed the need for man to cooperate with, not take control over, nature. The Keresans believed that their survival was directly controlled by deities whose nature they sought to define. Their genius lay in the creation of philosophical systems. while the Tanoans excelled in technological devices.

Pueblo Indian region of the Southwest



The arrival of the Keresans at the Rio Grande changed the human environment, and both village groups had to adapt. While Tanoan religious activity began to reflect Keresan theology, the Keresans adopted some of the Tanoan ideas of man's place in the natural world. Both groups revised some of their socioreligious practices. Changes were made in their systems of social organization, material possessions, and technologies.

In the late fifteenth century a third group appeared in the Rio Grande region. This group, composed of people who spoke a language known as Athapascan, again altered the environmental situation. The Navaho and Apache, contemporary names for the Athapascans, were hunters who generally lived in the highlands. Although small-scale raiding occurred, the villagers did not attempt to drive out the newcomers. A trading pattern developed between the highland and valley groups. For meat, deerskins, and wild foods from the Athapascans. the villagers exchanged corn and other farm-grown vegetables, cotton, and manufactured goods. Because the trade was beneficial to the villagers as well as to the hunters. the adaptation was positive.

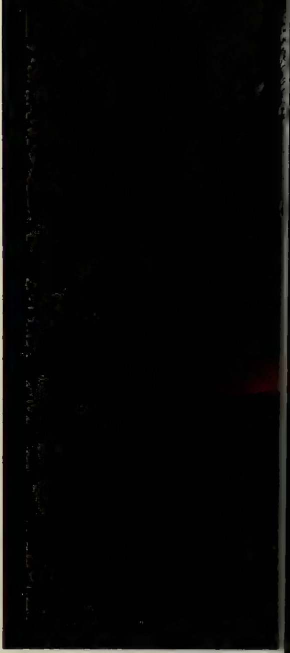
When the Spanish took control of the Rio Grande Valley in the late sixteenth century, they imposed rigorous policies of military conquest, colonization. and the establishment of an administrative government. Spanish missionaries and soldiers forced Pueblo men to build churches or chapels in the villages. Minor violations of Spanish rules were punished with imprisonment,
enslavement. or physical mutilatio
Villages that persisted in practicin
traditional ways were frequently a
tacked and often destroyed.

The Spanish placed extrao
dinary pressures on the Puebloa
adaptive techniques. On the o
hand, the Indians were required
either accept the Spanish religio
economy, form of government. la
guage, and social organization
be killed. On the other hand, if the
accepted these traits, thus giving u
their own cultures, Puebloan life a
such would cease to exist. The
positive response to these cond
tions is almost incredible.

The explanation for their su
vival is not to be found in Puebloa
conservatism, as is often claime
but in their adaptiveness and the
ability to select the beneficial a
pects of Spanish culture, while r
jecting the detrimental. For e
ample, the Spanish missionari
demanded that the Puebloans o
serve the special days of the Cath
lic liturgical calendar. The villa
ers, particularly the Keresans, h
their own calendrical sequence f
religious ceremonies. Adoption
the Catholic schedule could hav
had severe theological implicatio
for the Keresans. But the Keresa
found that the Catholic calenda
like their own. was geared to a se
sonal cycle. With a few minor re
sions they were able to hold the
animal. corn. and other observanc
on the days the missionaries consi
ered important. Thus, the Pue
loans held a deer dance at Chris
mas, an eagle dance on Epiphan
and other religious ceremonies
certain saints' days.

When the Spanish imposed the
administrative structure on t
pueblos, the residents shuffled a

A Pueblo woman displays pot
for tourists. The Puebl
make pots for selling, but
manufactured glassware
pans, such as the enamel
washbasin, in their ho



redefined the Spanish system. In a recent publication on the Pueblo Indians, the late Prof. Edward Dozier observed that official governmental positions forced on the villagers by the Spanish gave Puebloans the opportunity "to conduct secular matters separately, while their ceremonial activities [remained] under the direction of leaders unknown to outsiders."

During the three hundred years of Spanish domination, Puebloan culture changed extensively. Many villages were abandoned; others were relocated. All the villages came to have Catholic churches in their territories. New crops, textiles, species of livestock, crafts, and forms of labor were accepted. Spanish became the common language. The Puebloans of the nineteenth century were not the same as they had been three hundred years earlier. Even their name derived from *pueblo*, the Spanish word for village.

But they were still culturally and socially distinct from the Spanish. It is in this ability to retain their distinct identity, while constantly incorporating extensive changes into their society, that the adaptive success of the Puebloan people can be seen.

The United States assumed control of the Rio Grande region in the 1840's.

The new government brought restrictions on land and land use, a strong effort to eradicate Puebloan traditions through religious and educational policies, and a rapid increase in the non-Indian population. Again, Puebloan survival was seriously threatened.

The villagers, proceeding slowly and cautiously, began to make the necessary adjustments. English replaced Spanish as the common language. Wage work, instead of farming or livestock raising, gradually became the primary type of livelihood. As technology progressed, the people accepted such things as electricity and electrical appliances, plumbing, roads, automotive vehicles, hospitals, and medical technology.

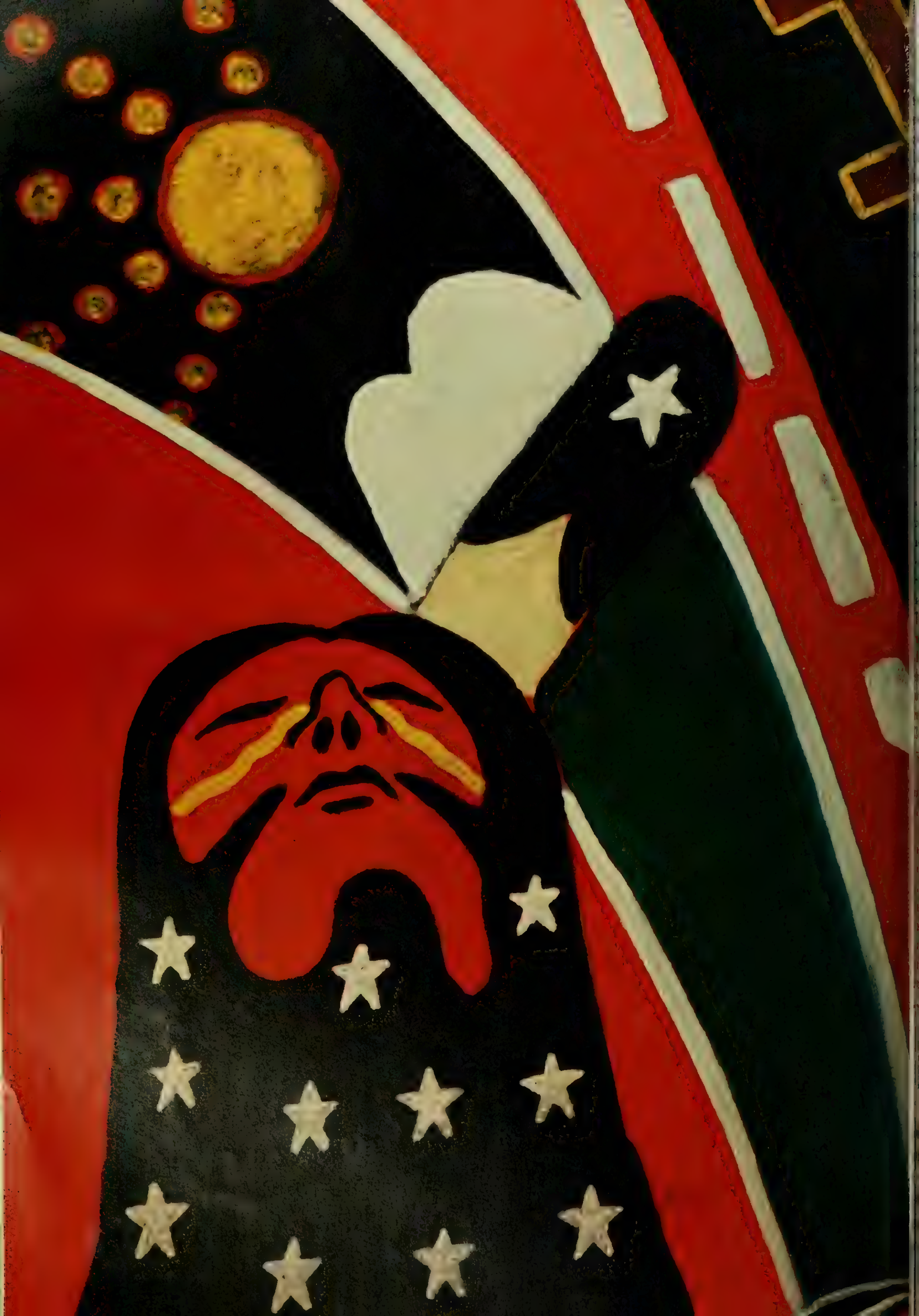
The villages changed. N
houses were built from new kin
of materials. Old houses were rem
eled. Concrete blocks were us
when adobe bricks began
crumble. Glass windows were
stalled in ancient walls. Doorwa
with wooden doors replaced roof
entrances. Stairways were built a
ladders discarded.

The villagers changed. Wom
made pottery for tourists instead
for home use. With the profits, th
bought glassware and modern co
ware. Men, whose working time w
once determined by the sun, gea
their work day to their employe
time clock. Their walk to the fie
was replaced by a ride in a car p
to an office or factory.

The villages and villagers of
1970's are much different from th
of the 1840's. But the women w
the Teflon-coated cookware and
men in the car pool are Pueblo
dians. They take pride in their
tinctive identity.

The process of creative adaptat
is associated with anguish, frust
tion, and pain. It is by no mea
automatic. It succeeds or fails
the basis of human decisions, wh
are frequently reached only af

For centuries, the Pueblo Indians have been pressured to adopt Christianity, but behind the adobe walls of their secluded villages, such as the Acoma pueblo, below, many traces of ancient beliefs remain. The three images, far left, are at the Institute of American Indian Arts, Santa Fe, New Mexico. Sunlight pours into the traditional roof entrance of a sacred kiva, left.



:tended discussion, bitter argu-
ents, and severe criticism. To
rerlook the fact that the Pueb-
ans, in order to adapt, have had
continually immerse themselves
this kind of procedure is to dis-
gard their humanity.

An idea of the drama involved
n be given by considering the vil-
gers' reactions to some of the
oblems confronting them today.

Poverty is a problem common to
the villages. Unemployment is
gh; income is low. Further, in-
me statistics are often misleading
cause the Puebloans' value sys-
n more or less obligates a person
share his income with relatives.
ius a Puebloan worker's paycheck
widely distributed.

The villagers sense that unless it
eliminated, poverty could signal
end of their traditions. They
o realize that possibilities for a
ution are extremely limited. The
ances of persuading industries to
ate on their land are remote.
ere are not enough jobs even in
h towns as Santa Fe. Los
umos, and Albuquerque. The al-
native of leaving the village to
rk in Phoenix, Los Angeles, Den-
, or other cities is often rejected.
leave the village is to end their
lition.

Efforts toward a solution of their
blem have generated emotion-
charged discussions in all the
ages. Villagers have been polar-
l into progressive and con-
vative factions. The utilization
outside consultants has caused
agreements. Some of the people
that consultants are needed;
ers maintain that, because they
not aware of village life and
litions, outsiders are useless.

n artist
Romero of Taos,
exico, mixes themes
ndian and American
s in this section
ne of his paintings.

Fighting has erupted in the council chambers. Friendships have been broken.

Nevertheless, decisions have been reached. Some of these reflect a great degree of caution. Others are imaginative and surprising. None has escaped severe criticism.

The villagers of Taos, Santa Clara, and Jemez have decided to develop recreational facilities for tourists. The residents of Santa Clara have already developed a recreation area complete with campsites and stocked fishing lakes. The people of Jemez are planning a large dam, which will provide flood control as well as recreational facilities. Taos, considered by many to be one of the most conservative of the villages, recently announced plans for building a tourist center that would include a large motel and possibly a museum.

The Acoma people, located on a 250,000-acre reservation about 60 miles west of Albuquerque, could not commute to jobs without great expense. To resolve their poverty situation, the Acoma are trying to interest mining companies in surveying their reservation for uranium deposits.

After a long sequence of complicated and bitterly criticized decisions, the people of Tesuque and Cochiti have leased large amounts of land for new housing developments. Tesuque people approved an arrangement whereby 1,300 acres of land would be leased for 99 years to a development corporation that plans to build a new community. Cochiti village residents recently leased 7,500 acres of land for similar purposes. The corporation in this case intends to build a city for some 50,000 inhabitants.

These different decisions may or may not alleviate the poverty problem, but they do illustrate creative adaptation, an often painful process whereby a society accepts new customs and practices, yet maintains a core of traditions that keeps it distinct as a group.

Population growth is another village problem. The number of Pueblo Indians has increased enormously in the past century. Dozier estimated that there are at least 40,000, the great majority living in the Rio Grande region.

One reason for the overcrowded villages is that while there are many more people than there were a century ago, there are fewer villages. In addition, inadequate water resources have prevented expansion.

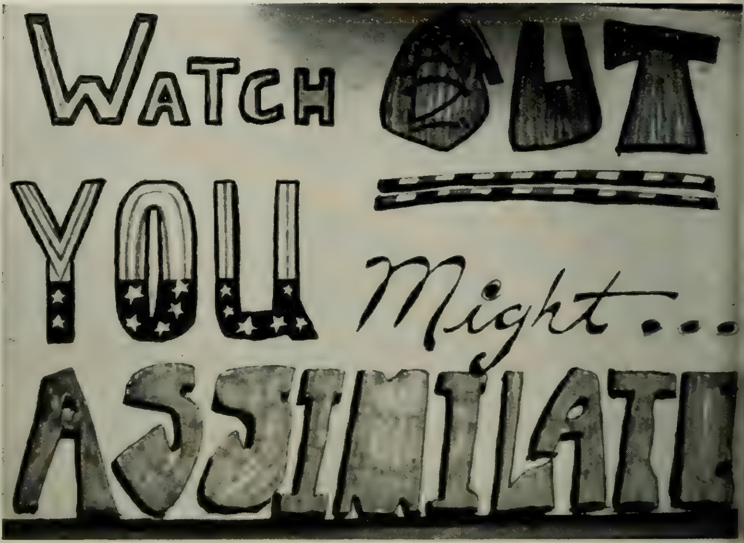
Resolution of the population problem entails more than simply building new houses. Such village traditions as ownership rights are involved: houses may be regarded as the property of the corporate group of villagers, a clan group, or the family. Other traditions specify who can live within the confines of the village. In some cases, eligibility is restricted to native-born people. In other villages, people born outside the area, as long as they are either Puebloan or married to Puebloans, are welcome.

The problems of poverty and population growth have forced the villagers to make decisions that have broad implications. Will a large village population decrease the effectiveness of the Pueblo social organization? Is it better for a village to limit its numbers or to allow expansion? A larger village population can command greater attention from the outside world. Is this desirable?

Before decisions about these matters were reached, villages were again the scenes of arguments, accusations, bitterness, and criticism. Anguish accompanied the creative responses. Some of the villages decided to allow large housing projects. In the Acoma area about 100 houses are being built. In Santa Clara, 75 new houses will be constructed. Several villages have so far opposed any new house construction.

Poverty and population growth are only two of the many problems demanding decisions from the villagers. Matters such as land rights, land claims, religious activities, education, the formulation of vil-

For the Pueblo Indians, all types of signs are important, such as the one lettered on the studio door of an Indian artist, right, and one alongside a road at Laguna, New Mexico, below. An old building in the Acoma pueblo, opposite page, has been remodeled with concrete stucco, large aluminum windows, and a street-level door, as well as the ubiquitous Coca-Cola sign.



RIBAL
REMONIES
N-INDIANS
EEP OUT

lage constitutions, and participatio in federal programs illustrate th complexity of the situation. Each o these will create frictions and factions before it is resolved.

The Puebloan villages are no sleepy, peaceful, quiet places. Th Puebloan process of creative adaptation can be chaotic. However. it i in accord with their tradition o recognizing and respecting differences. Each person and group in village is encouraged to express a opinion on any issue. Formulatin a decision in an atmosphere of disagreement and conflicting opinio is a difficult task. However, a decision made under such circumstances stands a good chance o being widely accepted and highl respected.

The Puebloans today may be facing some of the most difficult problems that the members of their cu ture have ever had to resolve. B through the process of creativ adaptation, the Pueblo Indians wi prevail.

OPEN
ENJOY
Coca-Cola
ICE COLD

Sky Reporter

This Is the Year to See Mars Anyone familiar with the southern sky of a summer evening, including the easily recognized constellation Capricornus, cannot fail to notice the bright red object passing through it this year. Even someone not familiar with the stars in the region will be impressed by the brightness and color of the starlike object, Mars, as it approaches its maximum brilliancy this coming August. From June to August, the planet will increase in brightness almost fourfold, to a brilliancy exceeded only by the moon and Venus among objects of the nighttime sky. Even Jupiter, far to the right of Mars and also an evening star this summer, will pale by comparison when Mars comes closest to earth this summer.

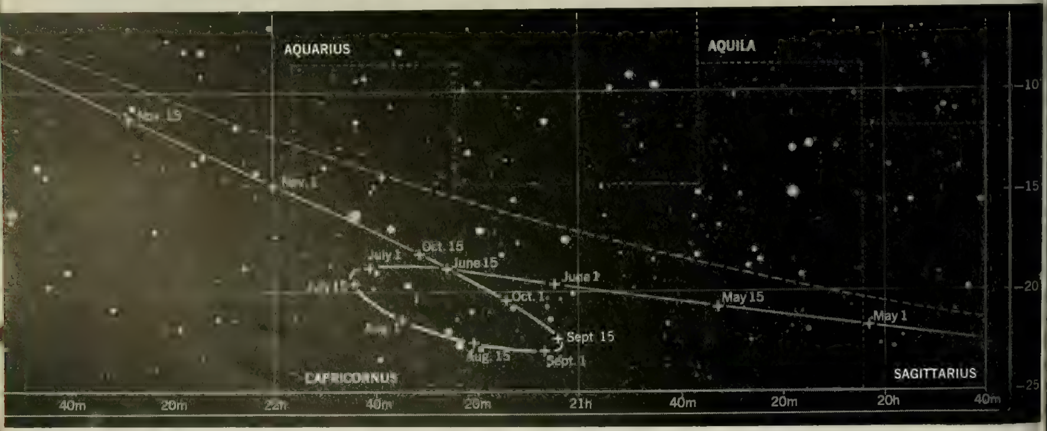
The brightness and prominence of Mars in the evening sky vary markedly over a 26-month period and also over a longer interval of 15 or 17 years during which it goes through seven or eight cyclical changes. The variations have to do with the relative positions of earth and Mars as each goes around the sun in different periods, bringing Mars nearest to earth every two years and two months on the average, and with the eccentric shape of the Mars orbit, which affects its distance from earth each time it comes nearest to us.

This summer, Mars reaches the place in its orbit where it is opposite the sun in our sky. The opposition itself, when sun, earth, and Mars are aligned, will o cur on August 10. And at this opposition, Mars will l nearly at the place in its orbit where the orbit itse comes nearest the sun and, therefore, nearest eart The latter circumstance makes this summer's oppos tion the most favorable since 1956, from the point view of Mars's brightness and prominence in our sk Mars, on August 10, will be closer to earth and bright than it has been in the past 15 years.

It will be interesting to watch the progress of Ma through the stars this summer and fall as orbital m tion (relative to our view from a moving earth) tak it through the stars of Capricornus, the Sea Goat, a as its brightness rises to a maximum on August and fades thereafter. The accompanying map can used to track Mars. The changes in its brightness can appreciated by periodic comparison with the brightne of Jupiter, to the right in Scorpius.

During June, Mars will be a morning star. It w rise before midnight and move up into the sout southeast by dawn before fading into mornii twilight. It will still be moving to the left (eastwar through Capricornus and will just about double

Positions of Mars every 15 days are indicated on th map of the southern sky. The planet will be in the midd of its retrograde loop when it is closest to us August 1



ghtness from the beginning to the end of the month.

The eastward (direct) motion of Mars will continue il mid-July, but at a continually slowing rate. On y 13, the planet will become stationary and will n begin to move westward (retrograde) back ough Capricornus, changing its position through stars to the right. This is the beginning of the trograde loop" that Mars goes through each time it nes closest to us. A great puzzle to astronomers be- the sixteenth century, we now understand it to be lative rather than a true motion of the planet, pro- ed because our viewing platform (the earth) is ing east more rapidly than Mars. At opposition, earth—moving east—overtakes Mars. And just as overtaken vehicle on a highway seems to move kward, relative to yours as you pass it, so Mars ns to slide backward (westward) as we overtake pass it going east.

he retrograde loop, beginning on July 13, will con- e until September 22, when Mars will again be- e stationary and resume its direct (eastward) mo- to the left. Still in Capricornus, the planet will h up again to its position of July 13 (when retro- le began) by October 21. Shortly thereafter, it will e eastward into Aquarius.

July, Mars will nearly double in brightness n, and by July 12 it will become brighter than ter, ordinarily the brightest planet seen through night (Venus, although brighter, always sets soon , or rises soon before, the sun). And in July, will rise shortly after sunset and dominate the hern sky for the rest of the night. It will be in the east in the early evening, highest in the south a hours past midnight, and still well up in the south- as it fades into the dawn.

roughout August, Mars will be visible all night, g about sunset, highest in the south at about mid- , setting about sunrise. Opposition will occur on st 10, and the planet will then be at its brightest gnitude −2.6). Thereafter, it will begin to dim, but will be so close throughout August that little ge in its brightness will be evident. It will remain twice as bright as Jupiter all month.

ring September and October, Mars will be a inent evening star, appearing well up in the east in late evening twilight, reaching its highest ion in the south well before midnight, and setting well before dawn begins. The planet will be setting close to midnight by the end of October. And, while it will still outshine any star you can see near it, Mars will be rapidly fading in brightness, dimming by nearly one-half again in October. After October 2, it will be fainter than Jupiter.

This summer's appearance of Mars is typical of the swift and brilliant oppositions it goes through each time a favorable opposition occurs. It is characteristic for the planet to linger for months as an inconspicuous morning star (as it did all last fall, winter, and spring), then suddenly grow to prominence while swiftly passing from the morning to the evening sky (as it does this summer), and then to linger again for several seasons as a lackluster evening star (next fall, winter, spring, and summer).

Near opposition, Mars changes in brightness so rapidly because, for a time, the earth is rushing almost straight toward the planet in the months before opposition and almost straight away from it for a similar period after opposition. Earth and Mars actually approach and separate at the greatest rate, however, well before and after the most rapid brightness changes occur in Mars. The reason for this, of course, is the manner in which Mars is changing its phase (as viewed from earth). In April, when Mars is approaching earth most rapidly, it looks from earth like a gibbous moon, with nearly 13 percent of its visible surface in darkness. In July, the distance is changing much more slowly, but Mars is then rapidly turning its entire sunlit surface to earth.

This opposition in 1971 will bring Mars closer than it was in 1956. The distance on August 11, 1971, will be 34,931,000 miles, while on September 7, 1956, it was 35,120,000 miles. But this slight difference actually has little effect on Mars's appearance. At opposition, the planet's distance can vary from slightly less than 35 million to slightly more than 63 million miles. Since 1956, for example, the distance (in millions of miles) at successive oppositions has been 45 (in 1958), 56 (1960), 62 (1963), 62 (1965), 56 (1967) and 45 (1969). At none of these oppositions did the planet come close to being as bright as it will be this summer. At all of them, however, the planet was far brighter than it is at positions other than opposition, when it can range up to 270 million miles from earth.

Thomas D. Nicholson

Celestial Events

From last-quarter on June 15, the moon goes through new moon on June 22, first-quarter on June 30, and full moon on July 8. Again at last-quarter on July 15, the moon is new on July 22, first-quarter on July 30, full on August 6, and last-quarter once more on August 13.

In June, July, and August, Mars becomes a truly spectacular planet in the southern sky, brightening continually as it approaches opposition on August 10, rising earlier each night until, at opposition, it rises at sunset. Jupiter, somewhat dimmer than Mars, is well up in the southeast to south at sundown and sets before dawn. Saturn is now a morning star in Taurus, rising well before the sun. Venus and Mercury are too close to the sun for observation.

June 21: Mercury is at superior conjunction and enters the evening sky. Venus and Saturn, although close to the sun, may be seen low in the east this morning below the crescent moon. The sun arrives at the summer solstice at 8:20 p.m., EST, and summer begins in the Northern Hemisphere.

July 4: Earth is at aphelion, farthest from the sun, 94,512,000 miles distant. The bright object rising above and to the right of the moon tonight is Jupiter.

July 10: It's Mars near the moon tonight, below and to its right.

July 12: Mars is stationary and begins to retrograde in Capricornus.

July 18: Saturn is near the crescent moon in the sky this morning.

July 22: A partial eclipse of the sun occurs today over parts of Asia and Alaska.

July 24: Jupiter becomes stationary, ending its retrograde and resuming direct (eastward) motion through the stars.

July 29: The Delta Aquarid meteor shower, with a single observer rate of 20 meteors per hour, reaches maximum. The first-quarter moon will not interfere with morning observations. Mercury reaches greatest elongation (east of the sun) in the evening sky. This is an unfavorable elongation; Mercury is only 11 degrees high at sunset.

July 31-August 1: The planet near the moon on the night of the 31st is Jupiter. On the evening of the 1st, Antares is quite close to the moon, Jupiter well to the right.

August 6: A total lunar eclipse occurs over most of the Eastern Hemisphere. The eclipse will not be visible from North America.

August 7-8: The bright red star below the moon is Mars.

August 10: Mars is at opposition, rising at sunset, setting at sunrise. Now at its brightest, the planet will shortly begin to fade rapidly.

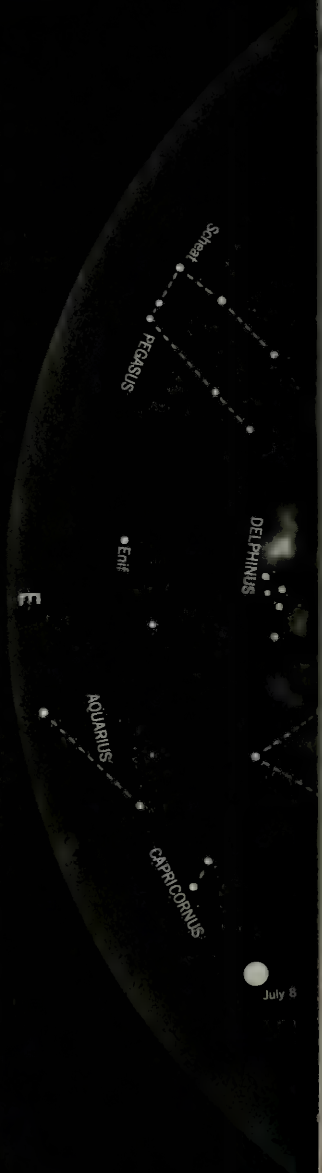
August 11: Mars is nearest earth, 34,931,000 miles distant.

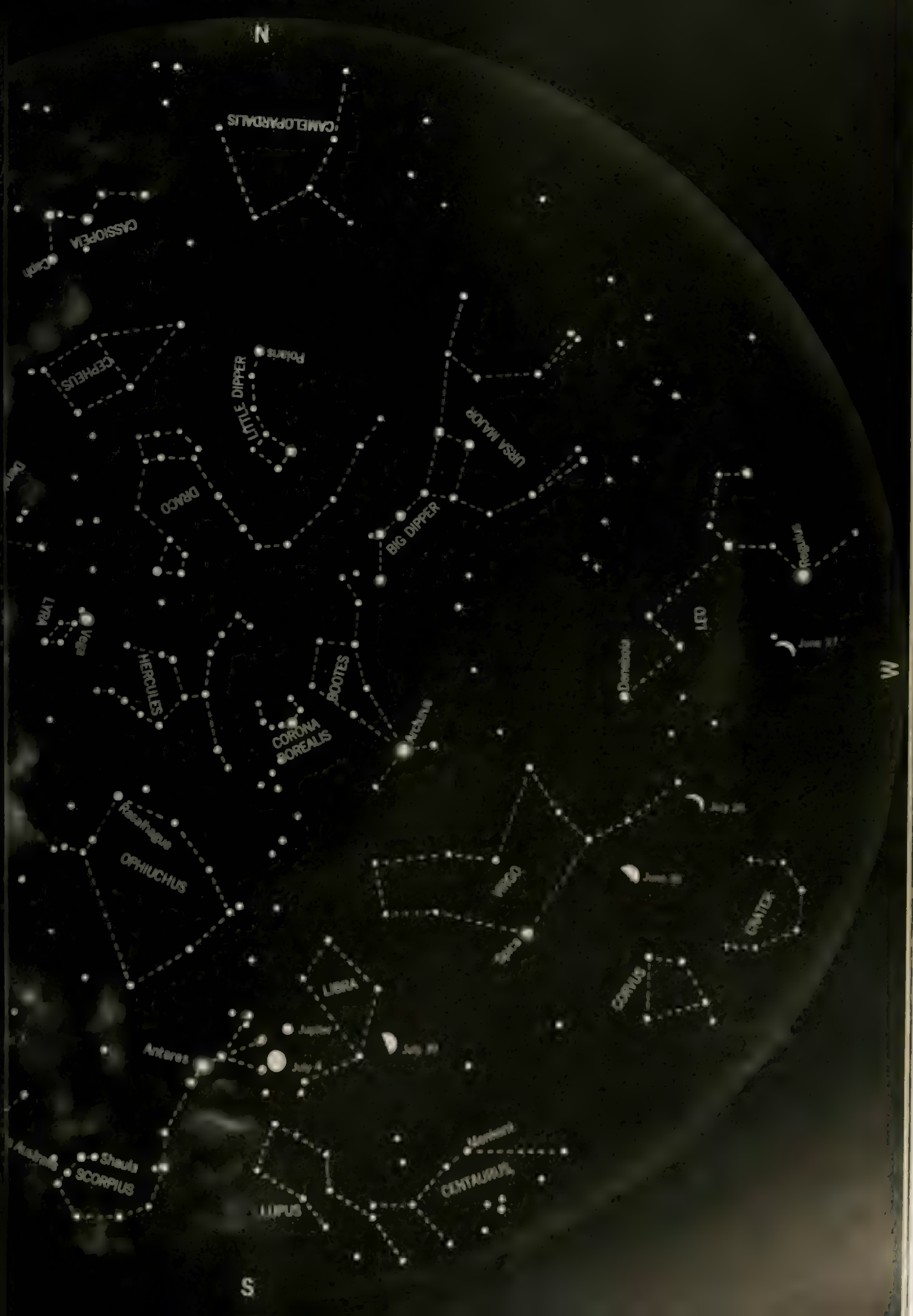
August 12: The Perseid meteor shower, best of the year, reaches maximum, but a gibbous moon will brighten the sky for after-midnight observers.

August 14: Saturn is near the waning crescent moon in this morning's sky.

Thomas D. Nicholson

★Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:25 p.m. on June 15; 9:20 p.m. on July 1; 8:25 p.m. on July 15; and 7:20 p.m. on August 1; but it can be used for about an hour before and after those times.




N
CAMELOPARDALIS
CASSIOPEIA
Caph
CEPHEUS
Polaris
LITTLE DIPPER
URSA MAJOR
DRACO
BIG DIPPER
LYRA
Vega
HERCULES
CORONA BOREALIS
BOOTES
Arcturus
LEO
Regulus
June 27
Denebola
W
July 28
Rasalhague
OPHIUCHUS
VIRGO
June 30
CRATER
Spica
CORVUS
LIBRA
Jupiter
Antares
July 4
July 3
Shaula
SCORPIUS
Menkent
CENTAURUS
LUPUS
S

A FUERTES SAMPLE

Audubon has his fans, but a good look at the watercolors of Louis Agassiz Fuertes may win a few converts

by F. G. Marcham

Louis Agassiz Fuertes was the first American, and perhaps the first person in the world, to earn a living painting birds. He illustrated more than sixty books and countless articles, painted scores of oils and watercolors on commission, and at his death, his studio contained more than a thousand pencil sketches, the records he had filed away in preparation for his more formal works.

His wish to study birds in their natural habitat took him far afield in both the United States and Canada; as a member of biological teams he spent many weeks and months in Alaska, the Caribbean, Mexico, Colombia, and Ethiopia. On these trips, his painting was secondary to his work as an ornithologist in the field.

On all of these journeys his days began at dawn when he went out into the forest, jungle, or ravine to watch birds and occasionally collect them. Returning to his base of operations at noon, he spent four or five hours skinning and preserving the birds he and others had shot. In the evening he painted and wrote up his notes. Fuertes did not follow Audubon's practice of taking a dead bird, arranging it in what he thought to be a lifelike pose, and holding it in that position by wires. Rather, he studied birds in action so that he could remember their movements and attitudes.

The paintings he made during these journeys had a special purpose. On many of the birds he shot, certain parts of the body quickly changed color after death—the eyes, the legs and feet, the bill. He made a rapid sketch of these parts as they appeared in life, and often, for safety's sake, wrote careful notes on the sketch to describe the colors exactly. Also, it was his opinion that some birds had in life a "bloom," or powdery color, on their feathers, like the bloom on a grape. These, too, he wished to record before the color faded. As the years passed Fuertes accumulated hundreds of such sketches, put them on file in his studio, and used them in preparing his formal bird portraits.

These portraits were for the most part used as illustrations for such works as Eaton's *Birds of New York State*, Chapman's *Birds of Eastern North America*, and Forbush's *Birds of Massachusetts*. When he painted the plates for these and other books he had to work within certain limits, much like the illustrator of an anatomy textbook. Perhaps the job called for a series of plates: one showing half a dozen different kinds of thrushes, another of flycatchers, and so on. In composing these plates, and in painting the pictures of the individual birds that appeared in them, his principal concern was, not the artistic excellence of the plate as a total picture, but the presentation of the birds in recognizable form. He had to highlight those features of the veery that distinguished it from the hermit thrush. Consequently, in many hundreds of plates of this kind, for example, that of the tree sparrow, he depicted a composite portrait of all the tree sparrows he had seen, not an individual bird he had held in his hand. The painting of these plates was, so to speak, his bread and butter work, his daily routine. But having to conform to the standard pattern of the plates kept him from reaching his highest level of performance, which is to be found in his studies of individual birds. In these studies, usually dashed off in a few minutes, he shows himself to be a superb painter in both watercolor and wash. In the two mediums his technical skill is exceptionally high. No one, not even the greatest of the Chinese masters, surpasses him in the use of wash.

His best watercolors, such as those presented here, have the qualities of immediacy and warmth: the bird or mammal is here, almost to be touched. This is the viewer's first impression. As he looks again he sees beauty in color and form, as in the cock-of-the-rock; and delicacy in rendering repose, as in the antelope jack rabbit. These watercolors, and others like them, were impromptu, informal, experimental works, inspired by a brilliant vision of color, as in the great blue heron; or by a sense of humor, as in the black-necked stilt.

Fuertes's career as a painter of birds was a natural outgrowth of his boyhood desire to learn everything he could about them: their identity, song, nesting, and migration habits. He kept records of birds with great care. But his records were only words and numbers. Not satisfied, he taught himself to draw and paint, so that he might also be able to record their color, form, and movement. As he wrote later, calling himself "the boy": "It was not the natural ability to draw which established the boy in the painting of birds but rather the opposite: his desire to learn accurately developed him in his crude and unlearned handling of the medium."

Fuertes was not entirely self taught. Abbott Thayer, an American artist of the first rank, saw some of his work in 1899 and immediately exclaimed, "Yours are the true thing." Asking Fuertes to come and live with his family, Thayer watched him paint and talked with him for hours about light and color, indeed the very business o

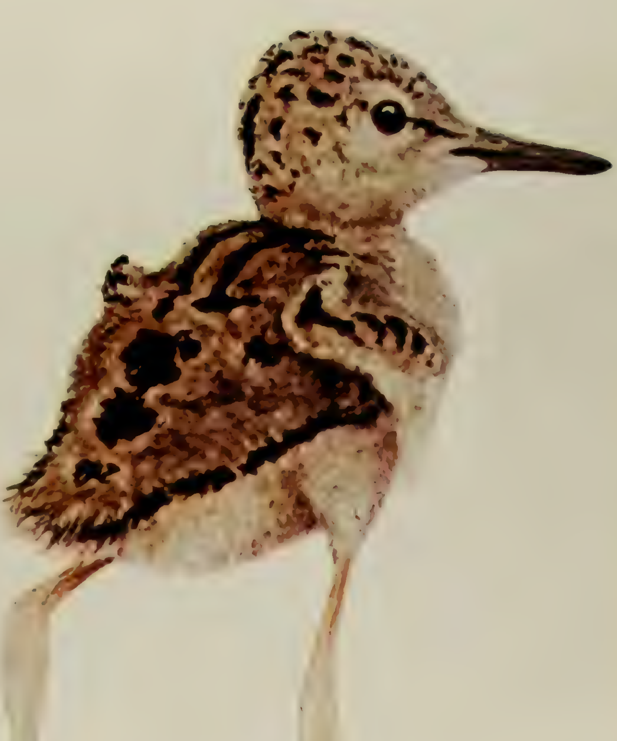
eing as an artist sees. Fuertes had
en strongly influenced by Audu-
n's works, but now he abandoned
; attempts to imitate Audubon,
d helped by Thayer, struck out
his own.

In later life he could say, with
ne justice, "I have been longer a
ident of the comparative anatomy,
pearance, and general 'personal
ks' of the birds themselves, and
ve spent a larger proportion of
time since boyhood in the direct
dy of birds, and have seen more
lely varied types in life than al-
st anyone I know."

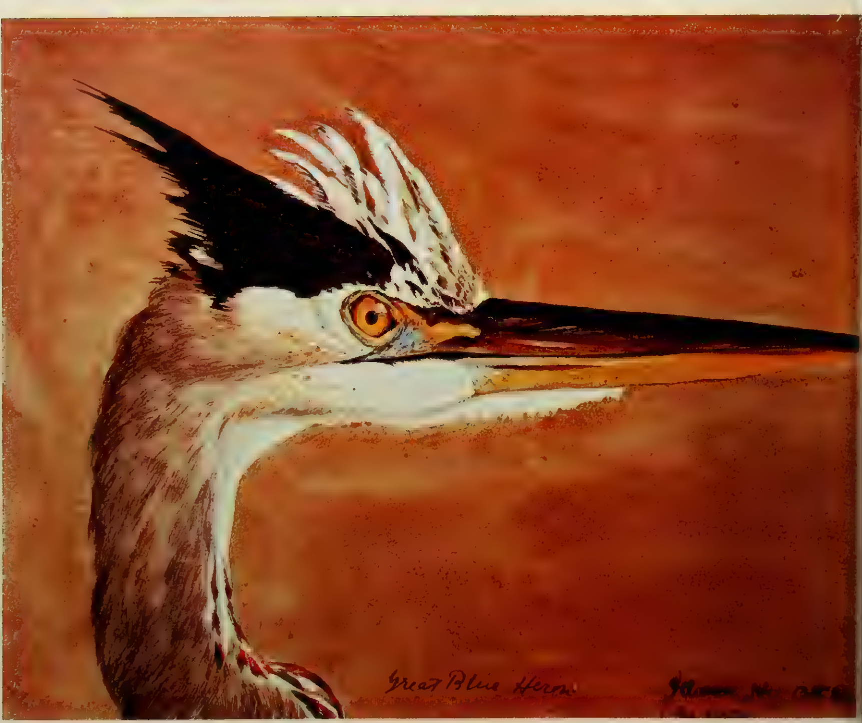
Today most of Fuertes's oils, wa-
colors, and drawings are scat-
ed across the country. The water-
ors, by volume and quality his
ncipal work, have suffered badly
m overexposure to light: per-
os 90 percent of them are already
ned. One large collection has
ently been badly damaged. A bu-
ucrat ordered some 250 of them
amed; another bureaucrat or-
ed frames of a standard size;
n they arrived, a third bureau-
t took out his shears and cut the
ures down to fit the frames. Only
out 20 went uncut.

ortunately, a large collection of
rtes's work—some 300 oils, wa-
olors, and drawings—are in the
session of The American Mu-
m of Natural History. Each
k of art is carefully protected.
watercolors and drawings pre-
ed separately in plastic covers
kept under lock and key in spe-
ly designed cabinets.

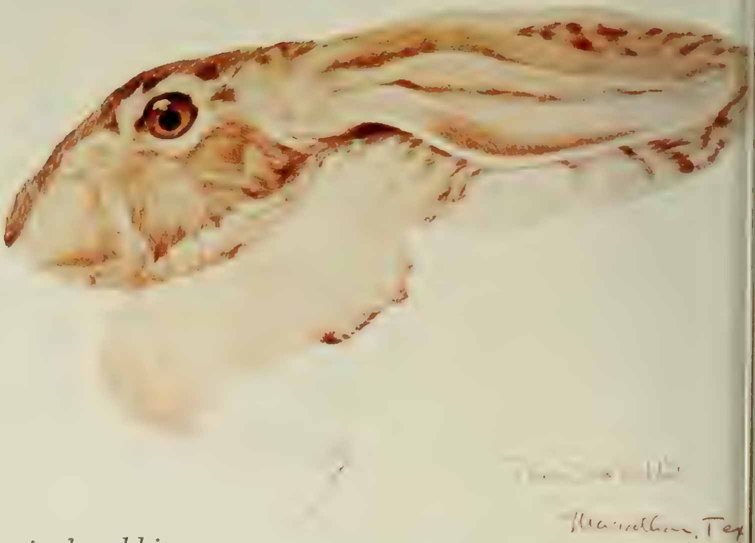
he collection came to the Mu-
n through Dr. Frank Chapman,
early chairman of the orni-
ogy department and a lifelong
nd of Fuertes's. To him fell the
ancholy task of arranging for
purchase from the artist's
ow. Fuertes died at the age of
on August 22, 1927, in a grade-
sing accident near his Ithaca
e. The cause, some say, was a
k of birds that distracted his at-
ion.



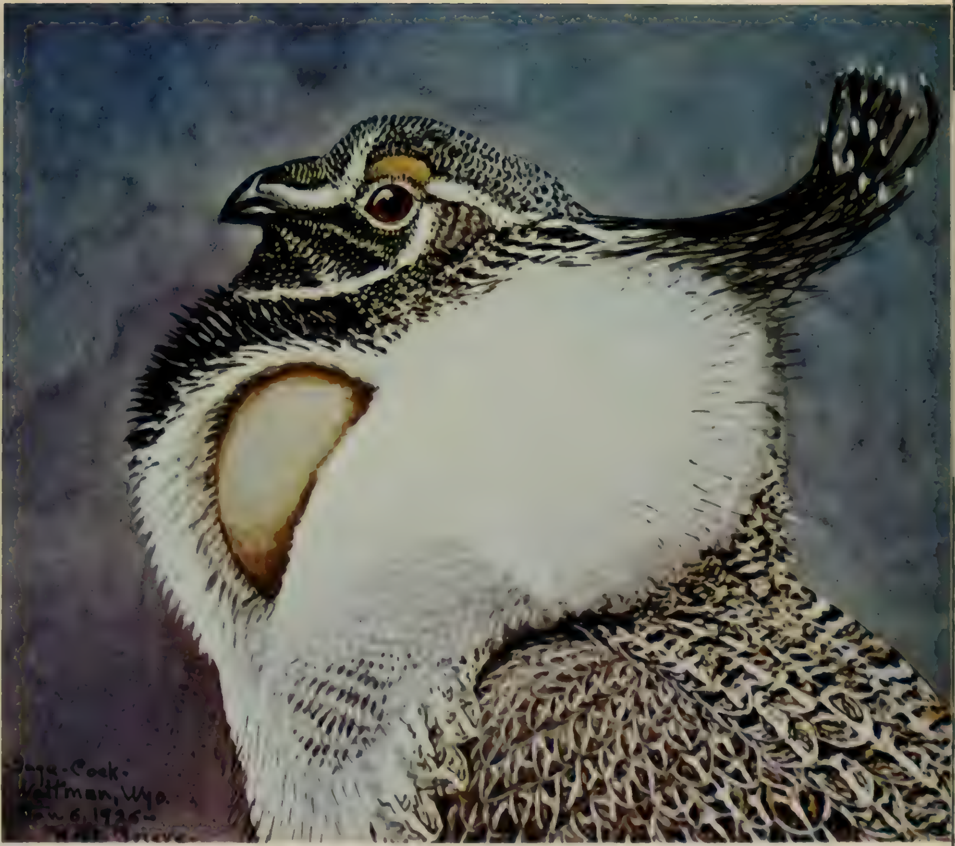
Black-necked stilt


Great Blue Heron

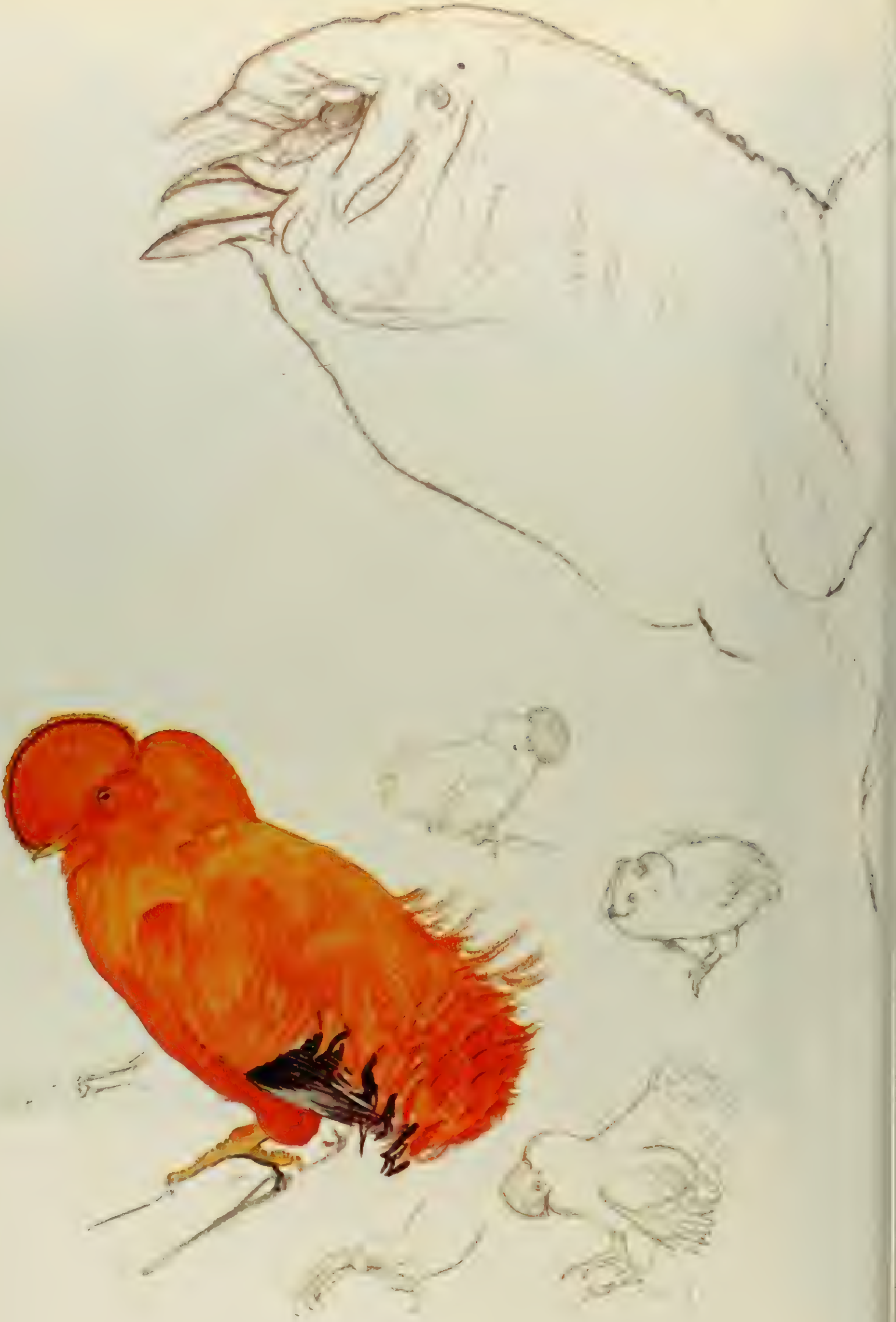
Great blue heron


Marathon, Tex

Antelope jack rabbit

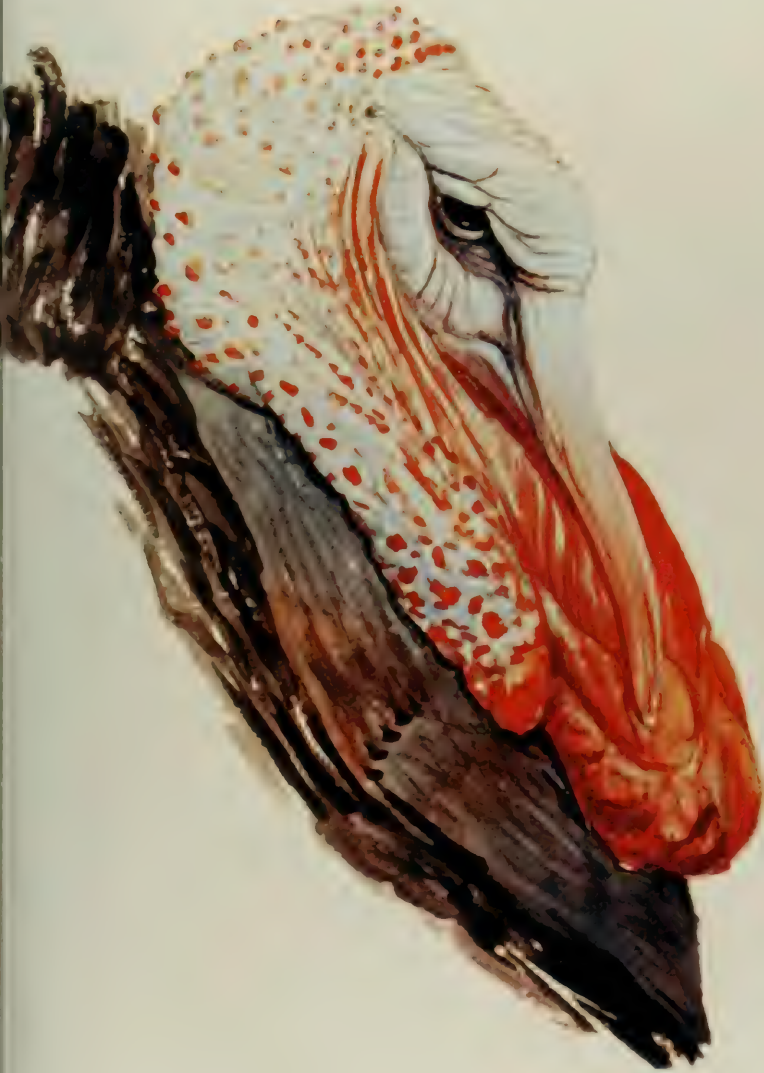

age-Cock.
Wattman, Wyo.
ew 6, 1926–

Sage grouse (male displaying)



Guianan cock-of-the-rock

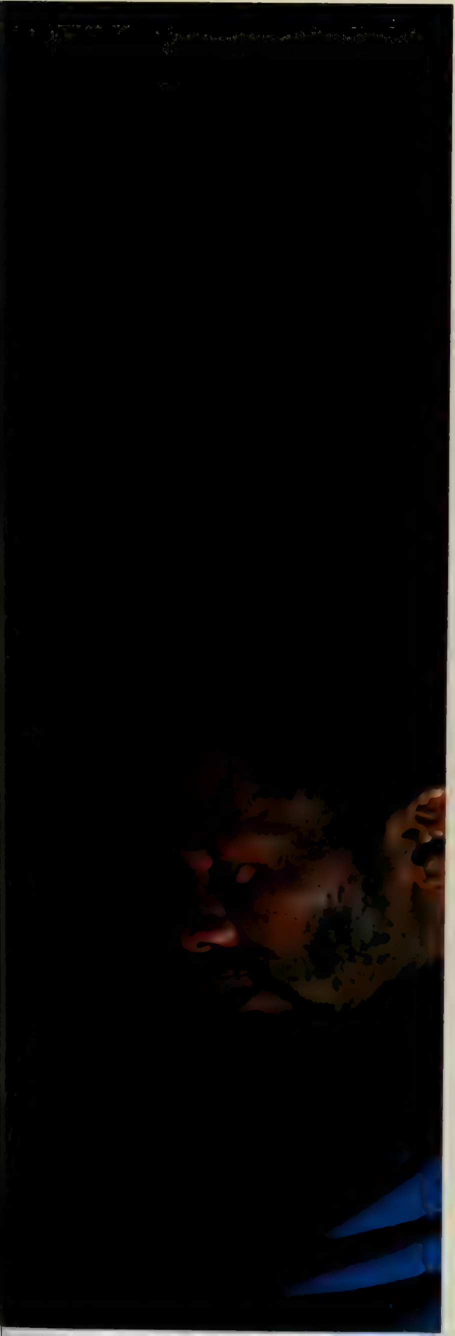
Common turkey



ZULU ZIONISM

hrough ablution in the purifying sea and communion with the oly Spirit, South Africa's Zionists seek release from world of social deprivation

by James W. Fernandez



On any Sunday afternoon in any city in South Africa, small groups of people dressed in colorful robes rush to their appointed places of worship in vacant lots or roadside parks. Since these black Africans have neither the permission of the South African government nor the means to build churches of any permanence, the greatest number of them worship in the open air on land that is otherwise unused. Over the years their rituals have worn away the grass, churning and beating the soil into shallow trenches that are nearly perfect in their circularity. On weekdays, I would experience an archeologist's feeling of discovery as I passed by these sites of former, intense activity in the wastelands of the city. But I had only to return the

Zulu evangelists, left and below, conduct indoor services. Such evangelicalism combines traditional African beliefs and Christian practices.

following Sunday to find them alive with chanting worshipers.

The more than three thousand independent sects, cults, and churches, large and small, that flourish among South Africa's blacks represent attempts to combine, in one form or another, traditional views with those of Christianity. These movements present us with novel and often creative styles of life, and they have an exuberance that rewards those who seek to learn more about them.

In South Africa, the blacks, predominantly Bantu peoples like the Zulu, constitute an overwhelming majority of the population (68 percent). Some 10 percent of the country's people are coloreds of mixed European and African descent who are a distinct group politically and socially. Virtually all governing powe and social prerogative is exercised by the 19 percen of the population that is white. The small remainin number of people are Asian.

In recent years the modern world has forcibly exported its culture of science, technology, and materia consumption to the countries of the Third World. W may forget that long before we began to export ou scientific-technological culture, we were making devoted efforts through missionaries to export a mor metaphysical, otherworldly, and ascetic religious on

Stamping their feet and singing left, the congregation makes its way to the water's edge in a manner suggestive of Zulu power in the last century. Zionists are careful to confess worldly sins before entering the pounding surf to purify themselves, below.

ıave been studying the reactions to that earlier en-
prise. Regardless of how Africans will eventually
pond to our secular culture. their response to the
lier evangelization has not been one of simple imi-
ion. The deeply ingrained religious beliefs and
ıctices of African peoples have not been abruptly
andoned.

The new religions springing up today are called
vements because they are attempts to move away
m colonial domination and deprecation toward a
re authentic and satisfying African society and cul-
e, which will combine African and European in-
ences without a grievous sense of disparity.

Part of our interest in such syncretic movements
ses from our having seen their like before. History
sents us with many examples of contact between
ples that resulted in a synthesis of old and in-
duced elements. Christianity itself, we know, grew
of a mixture of Hebrew and Hellenic cultural ele-
nts. The two influences are emphasized in varying
rees in Christianity's many branches and denomi-
ions. Similarly, the new African religions differ
ong themselves, in their adherence to Christianity
the one hand and to traditional beliefs and prac-
s on the other. Some are very traditional, while
ers are virtually indistinguishable from their Chris-
mission antecedents. Some are down to earth. and
e enthusiastic. Some are large, holding many thou-
ds in the same communion. Others are small in
ber and ephemeral in time.

he Zulu Zionists are part of a colorful movement
ranges from hundreds of small, transient groups
stablished churches with thousands of members.
enthusiasm they generate in worship is dramatic
he eye and ear. This movement is instructive even
he smallest groups because the fundamental syn-
ic and adaptive processes of culture contact, often
ured in larger and more complex movements, are
evident in them.

he name Zionism, to which these groups are at-
ed, has nothing to do with contemporary politics
he return of the Jews from the Diaspora. In a
e way, some Zionists feel that the name does dem-
rate their attachment to the biblical homeland and
specifically to the Old Testament, the part of the
they find particularly relevant. But for most
, it is an attractive term, alliterative with their
tribal name and evocative of an ancient place of
tual authority. "It refers to a mountain on which
loly Spirit healed man," some say.

e term, surprisingly enough, was brought to
h Africa at the turn of the century from Zion
Illinois, on the shores of Lake Michigan, by mis-
ries from John Alexander Dowie's Christian
olic Apostolic Church in Zion. These mis-
ries, called Zionists in South Africa, believed in
piritual power of divine healing by the laying on
nds and in baptism and healing by triune immer-
Dowie's own theocratic community in Zion City
broke up, however, and the mission effort was
loned by the end of the first decade of the century.

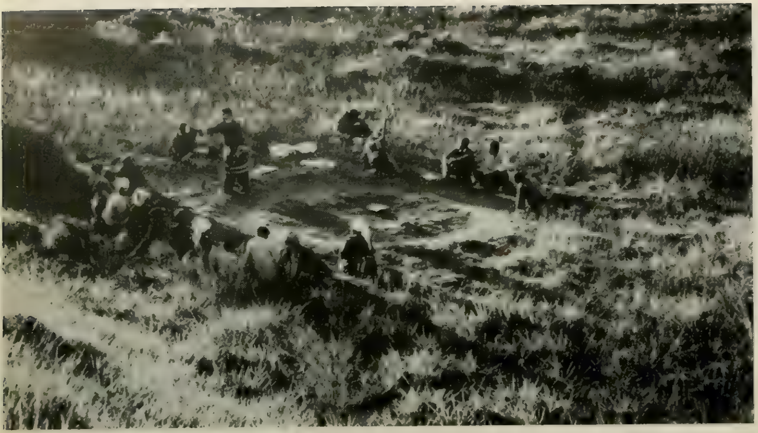
Meanwhile. the South African Zionists. who had also begun to experience division among themselves, were to feel a second influence from American enthusiastic revivalism. This was the influence of Pentecostal or Apostolic Faith missionaries who preached Pentecost, or "baptism in the Holy Spirit." These missionaries. in their turn, ceased to have any important direct effect on Zulu Zionism after World War I.

But indirectly. elements of both evangelizations remain, and Zulu Zionists continue to place central emphasis on healing by faith and the laying on of hands, on repeated immersion, and on the efficacy of the Holy Spirit. Zionist pastors who succeed in building up large congregations still try to establish self-sufficient theocratic communities with crafts and local industries free from external contamination. These communities are not much different from the original Zion City, which under Dowie's direction was aimed at excluding the patent immoralities of Chicago and northern Illinois.

Actually, not many large Zionist congregations are forthcoming. The qualities of charismatic enthusiasm necessary to Zionist prophecy are not usually compatible with the executive talents needed for large-scale organization. It is not unusual to find a pastor ejected from his own community, as was Dowie himself. By the 1920's, not long after the period of the evangelization, there were already dozens of these small Zionist churches. They now number in the hundreds, carrying such resplendent names as the Church of God in Christ Zionist (300 members), Zion Apostolic Gaza Church of Heaven (50 members), and the Circle Zion Church of God (12 members).

On Sunday afternoons, the various parks and empty lots of South African cities are dotted with the brightly clad devotees of these different religious persuasions. The women gather first, coming from the servants' quarters in which they are housed, for Zionism is largely the religion of the servant classes. They may come in their robes or bring them in bags. As they deck themselves out, they chat excitedly with other early arrivals. They sit together in the grass until the *mfundisi* (minister) and his deacons, one or two in number, arrive. The deacons, young men training for the ministry, are often quick to take any disgruntled members off to a circle of their own.

Membership in these circles is volatile, and members, predominantly women, are ready to move on if the service does not meet their requirements or if the minister seems to be a man of inadequate power. On the other hand, the *mfundisi*, trying to extend his influence and his income from the small offerings available to him, may move out to other circles that seem to have weak leaders, sending back a deacon as assistant minister to manage the affairs of his original circle. Sometimes this can be well managed, and an able and ambitious man can become bishop to many circles. But as often, his deacon or an interloping minister without a circle will intervene. Sometimes no leader will appear, and the common members will continue to arrive and wait for several Sundays in a row.



In vacant lots amid a city's grid of mortar and steel, worshipers recapture the symbolic circular world of Zulu life, left. "Heating up the circle," below, creates a propitious atmosphere for coming of the Holy Spirit.

finally moving off to worship in other circles. Or, the bishop will one day return to an old circle to find a new *mfundisi* not in his allegiance. When this happens a quiet struggle usually ensues between them. They test each other in strength of preaching, of praying in tongues, of the laying on of hands. Eventually the issue is decided; but if it is not done quickly, the membership, dismayed at this burden on their worship, will abandon the *mfundisi* to their struggle.

The circle formed at a Zionist service is a simple affair, yet it is the center of compact and highly charged religious activity. It is so important to the worship of these small Zionist congregations that it is often painted on the beaten mud or concrete floors of huts or township dwellings where the Zionists meet in inclement weather or at night. To Zionists, the circle has a deep symbolic significance, which is the more surprising because no explanation is ever given of their colorful garments, appliqued with stars, moons, and crosses that simply come in dreams.

The importance of the circle can only be grasped when one considers the round world in which the Zulu traditionally lived: round beehive houses protected by a circle of thorn bushes, the whole surrounding a circular pen—the heart of the kraal—which contains the main object of Zulu devotion and desire, the cattle. Amidst the harsh rectangularity, the gridiron of Western urban life of which the Zulu cannot become a part, their circles recapture this round world: the circle within a circle of traditional Zulu life. Just as they try to return yearly to kraals in the reserve to renew a sense of traditional composure and a special power over their afflictions, so they recapture some of that composure and power within their circles.

When the congregation, usually ten to twenty people, at last arrives, they gather around in a circle while the *mfundisi* or his deacon talks about the good results of previous worship and healing and the plans for future meetings. If he feels the moment propitious, the *mfundisi* may at this point deliver a homiletic. He

extends a hand over the circle to bless it. The membership then begins to sing, usually songs from missionary hymnals accompanied by a drum.

After several minutes of this, someone may burst out speaking in tongues or take up a passionate testimony. Others will begin to run clockwise around the ircle, "heating it up" and making it congenial to the oming of the Holy Spirit. The songs and the drum ick up tempo as those afflicted, who have previously dentified themselves to the *mfundisi*, are brought into he center of the circle for the laying on of hands midst the circling membership. This is usually done y the *mfundisi* or his assistant, or by a deaconess *makokeli*). Dancing and weaving in unison with the ongs and drum, they grasp various parts of the afflicted body, spasmodically, compulsively, transferring he power of the Holy Ghost from within themselves to he afflicted individual.

It is at this time, particularly, that possession by the Holy Spirit may take place. Such a powerful penetration by the supernatural occurs that the recipient seems to lose his senses. He begins to shudder and shake and to exclaim in descending bursts of sound, "Heh! heh! heh! heh! ohh!" His muscles may jerk and shoot him forth uncontrollably in one direction or another. If this happens within the circle, it is a good sign. It shows the effective encounter and conquest by the Holy Spirit of the evil forces within. It is a most satisfactory consequence of the laying on of hands.

But it may occur even before the person enters the circle or has hands laid upon him. If so, it is a sign of his impurity, of his unacceptability to the Holy Spirit. The reaction may become so powerful that an individual is thrown out upon his back, and when this happens, he must examine his inner self. He must confess those cold-spirited intentions within his own power that closed him to assuagement by the Holy Spirit. In every case, when the Holy Spirit acts powerfully upon a man or a woman, either inside or outside the circle, other members come to his aid, physically supporting him against the raging spirit.

Gradually the vertiginous running about in the circle ends. The action of the Holy Spirit within flows away. It is twilight. The members move to the outside of the circle and return to softer singing. It may now come upon the minister to embark on a long sermon. Finally, a small suitcase may be set in the center of the circle and the members individually step forth to make a contribution. A benediction is pronounced, and the women resume their chatting. Farewells are said, and the grassy circle, now dusty with the churning of many feet, is abandoned for another week.

The primary mode of spiritual contact in the meeting just described, the laying on of hands, is an art. A *mfundisi* must know the focuses of affliction. He must know the spiritually sensitive zones: the top of the head, the back of the neck, the small of the back, and the breast bone are most likely spots. He must know *when* to lay on hands. Some ministers, overeager to communicate their powers, lay on hands too quickly. Others build up a tension so that the Holy Spirit charges into the member with thunderous, corporeal consequences.

For the Zionists, the laying on of hands is only a technique. The crucial element is the Holy Spirit, the circumambient ether, inert to most men but which some men may appropriate for greater strength and power over hardship and evil. The Zionists are held in some disdain by the established churches because they seem to pay only lip service to the other two Persons of the Trinity. But the reason is not so hard to find The Holy Spirit is much more easily identified with their earlier worship of the spirits of the dead. It was the principal object of the Zulu cult of the dead to hold effective communication with these spirits and to obtain from them health, freedom from affliction, and the good things of life. One may even speak of the Holy Spirit in some of these cults as a kind of generic ancestral spirit, a generalization or abstraction from the traditional multitude of particular spirits, that evolved out of culture contact and the challenge of monotheism. Devotion to the Holy Spirit is a kind of ancestor worshiper's version of monotheism.

In the old days among the Zulu, one looked for signs of the presence of spirits in certain natural events: small whirlwinds in the dust of the courtyard, the sound of wind sighing through the reed roofs of the huts, the presence of a serpent coiled in a corner or curling across the kraal. There has always been a tendency to find traces of the spirits in natural phenomena, but among Zionists it is often more explicit—the Holy Spirit is identified with the wind itself. The words spirit and wind are the same in Zulu (*umoya*). The Zionists carry large flags to their circles and plant them on the fringes. They are never so content as when the sea breezes of the Indian Ocean whip these back and forth, a good omen, if not an index, of the forceful presence of the Holy Spirit itself.

If the power of the Holy Spirit is suggested in the wind, it is even more convincingly present in the source of the wind, the ocean itself, whose constant movement suggests omnipotence. Zionists not only u sea water for personal ablutions, but they descend p riodically to the ocean for purification and rebaptis in the Holy Spirit. The Zulu have traditionally us streams and ponds to purify themselves. At the Zu New Year festival, the king would descend to mi stream and wash himself with the ashes of sacrific cattle. The ashes floated down and were in turn tak up by his warriors in the waters below to purify the selves. In these ablutions the king and his warrio were not only purified but were at the same time fill with the power of the royal ancestors.

If the Zionist congregation is a large one, this oce baptism is a truly impressive event. It takes place first light in the morning. The members first prepa themselves by confessing to each other on the fring of the beach. Taking unconfessed sins into the water dangerous. The Zulu are not good swimmers and t Indian Ocean surf pounds in with a strong underto The occasional drownings of Zionists undergoi purification baptism are always explained as a co

sequence of an unconfessed heart punished by the Holy Spirit. Members who feel themselves particularly impure first purge themselves in the traditional manner by vomiting into a hole in the sand. It is covered over and two candles are lit above it.

After confession, the entire congregation gathers at the top of the beach and dances down to the water's edge singing songs from Christian hymnals and the old regimental songs of the Zulu *Impis* (bands of warriors). It is a scene reminiscent of Zulu power in the last century. As the congregation moves down the beach, the men raise their knees high, stamping down in unison into the sand dunes. When this Zionist *Impi* arrives at the water's edge, they halt and form a line out into the shallow surf. With hands outstretched, the leader then goes forth waist deep into the surf, announcing to the Holy Spirit that men have come to be purified. Then, one by one the Zionists go forth to be totally immersed in the element.

When all are baptized, they reassemble on the beach. Now, full of power, they dance back to the dunes, again singing the regimental songs. The leader cups his hands over his ears, a sign of the presence of the Holy Spirit within him. If there is anyone in the congregation whose illness has long resisted the ordinary laying on of hands, he is now brought forward. The empowered congregation gathers in a circle around him. Their new spiritual power, concentrated through their leader as he lays on hands, cannot fail to cure even the most chronically afflicted. Then the members disperse. They are purified, in composure with spirit, and have a clarity of vision that immersion in roiling water has always obtained for the Zulu.

Thus, the major ceremonial events of the Zulu Zionist religion are formed out of the bare elements of water, wind, and simple circles in the grass. Any material affluence is denied these servants and workers who are aliens in the European cities of southern Africa. Yet, out of the remnants of their own religious tradition and in syncretism with a new one, their desires and their imaginations obtain, if only on days of worship, a buoyant triumph over depressed circumstances.

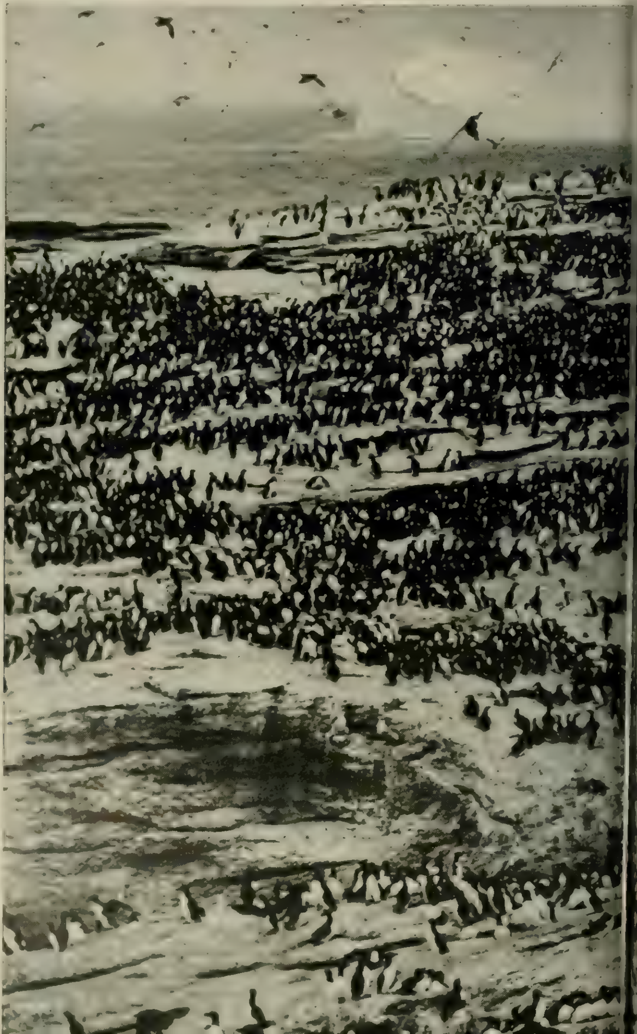
A worshiper, center left, enters trance as a Zionist minister attempts to drive out evil forces. Zulus believe the power of the Holy Spirit flows from the healer into the body of the afflicted.

FUNK ISLAND

by Fred Bruemmer

Graveyard of the great auk, this speck in the ocean has become the nursery of almost two million seabirds

Forty miles to the east of Newfoundland, the island rises like th gray back of a giant whale from th icy waters of the Labrador Current It is only 800 yards long, 400 yard wide, and 46 feet at its highes point. Yet Eskimos and Vikings visited it. and Newfoundland's now extinct Beothuk Indians risked thei lives in frail bark canoes to reac this remote island. Polar bear swam far across the sea to clambe up its difficult shore. Jacques Cartier landed on the island, and fo four centuries, hundreds upon hundreds of ships from Spain, Po



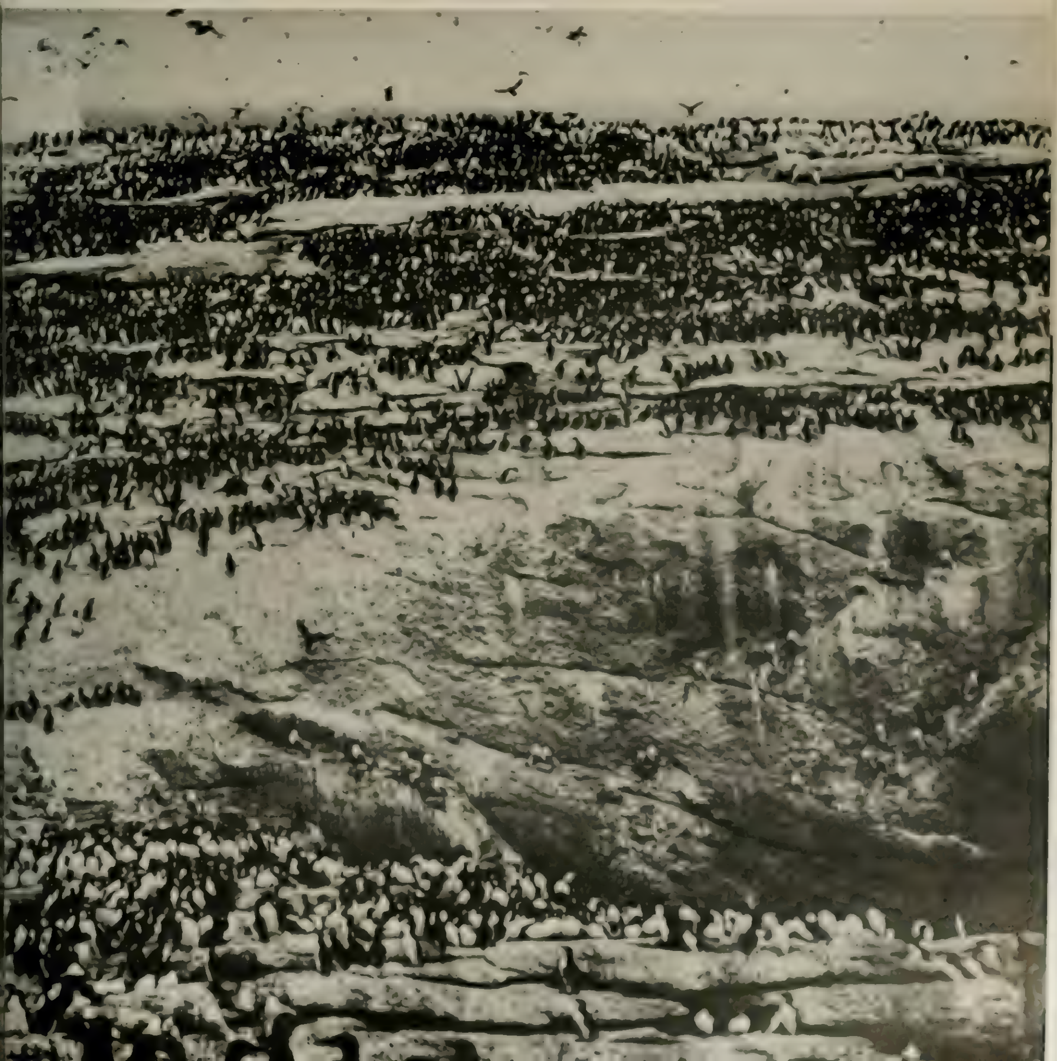
More than 1½ million common murres nest on the island in three rookeries. Clinging to the little unused space that remains, kittiwakes nest along miniature ledges on the cliff face.

ugal, England, and France sought out this barren rock in the frig- d fog-shrouded sea. For this is 'unk Island—already prominently narked on the 1505 Pedro Reinel nap as "Y.-dos-aves," island of irds—once a home of the now xtinct flightless penguin of the orth, the great auk.

"This island is so exceedingly ull of birds that all the ships of 'rance might load a cargo of them ithout one perceiving that any had een removed," wrote Cartier in 535. He had landed on the rock in 534, killing auks, "and our two long-boats were laden with them as with stones, in less than half an hour." He took another two boatloads in 1535. From his description it seems that murres, razor-billed auks, and gannets also nested on the island, in addition to great auks.

The wealth of fish off Newfoundland attracted hundreds of ships from Europe each year, and Funk Island became their larder. In 1578, 50 English and 350 French and Spanish vessels caught fish in the vicinity, and as a contemporary writer noted, the fishermen "doe bring small store of flesh with them, but victuall themselves always with these birds." The great auks were trusting and easy to kill, and Richard Whitbourne, in his 1622 description of Newfoundland, praised "God [who] made the innocencie of so poor a creature . . . such an admirable instrument for the sustentation of man."

The great auks were superb swimmers: they outpaced with ease a boat rowed by six sailors. But on land, the erect and stately birds, nearly three feet tall, were slow and helpless. The English expedition of



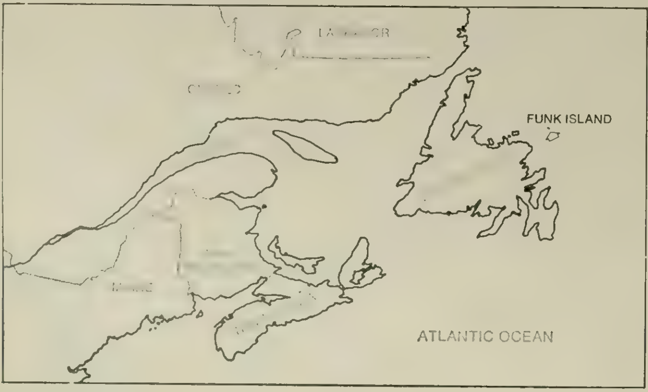
"Master Hore and divers other gentlemen . . . in the 28 yere of king Henry the 8 [1536]" simply "drave a great number of the foules into the boates upon their sayles."

The auks were herded to boats and death for centuries. In 1785, Capt. George Cartwright wrote: "When the water is smooth, they [the fishermen] make their shallops fast to the shore, lay their gangboards from the gunwale to the rocks, and then drive as many penguins on board as she will hold."

These were the original penguins. To this day, old Newfoundland fishermen recall tales of their forefathers who went to "the Funks" to hunt "pemwins." The name was later given to the equally stately, flightless birds of the far south. The word, some believe, comes from the Welsh *pen*, "head"; *gwyn*, "white": for the great auk bore two large white marks upon its dark head. Sir Richard Peckham in his account of Sir Humphrey Gilbert's voyage to Newfoundland in 1583 claimed Funk Island had been discovered by the semilegendary Maddock ap Owen Gwyneth "from the blood-royall borne in Wales," who is supposed to have visited Newfoundland in 1170 and named many places, including "the Island of Penguin, which yet to this day beareth that name." According to a less romantic etymology, the word *penguin* is derived via Spanish or Portuguese from the Latin *pinguis*, or "fat."

And fat the great auks were. In the latter part of the eighteenth century, Captain Cartwright reported that "several crews of men . . . live all summer on that island for the sole purpose of killing birds for their feathers." The men first herded the auks into large stone pounds, then threw them into great caldrons of boiling water to loosen the downy breast feathers. Since there was no wood on the barren island, the fat bodies of the auks were used to stoke the fires beneath the kettles. Even now, the island's surface is seamed in black by charred layers of auk bones, and in yellow-brown by the crushed shells of auk eggs. In 1863 Thomas N. Molloy, United States consul at St. John's received permission to mine auk remains on Funk Island. Thirty-five tons were taken away; five were sold at $19 a ton in St. John's, Newfoundland, the rest were shipped to Boston, Baltimore, and Washington to fertilize the gardens of the wealthy.

By about 1800 the great auk was extinct on Funk Island, its only known breeding place in North America. By 1830, great auks survived only on two islands off Iceland. In that year a portion of Geirfuglasker Island, the more remote and inaccessible of the two, sank beneath the sea in a series of volcanic eruptions. The birds then bred only on Eldey Island, but fishermen continued their relentless pursuit. They took fifteen in 1830, twenty-four in 1831, thirteen in 1833, nine in 1834, and three in 1840.



On June 3, 1844, a boat wit fourteen men set out from Icelan for Eldey Island. Three landed " great risk." They spotted two auk that, as the men approached, "ra along under the high cliff, thei heads erect, their little wings som what extended. They uttered no cr of alarm, and moved with the short steps as quickly as a ma could run." But the men cornere them before they could reach th safety of the sea, strangled then and threw them into the boat. Or of the men, returning to the bla lava shelf where the auks had fir been seen, found the pear-shape fist-sized egg of a great auk. F smashed it, the last egg of the la of the great auks. The men sold tl two auks for £9. Their viscera a preserved in a museum in De mark.

Today, tons of brownish, di integrating bones on Funk Islan feathers in the beds of some fis ermen, and 78 skins in the world museums are all that remain of tl great auk. Toronto's Royal Ontar Museum recently acquired Canada only great auk skin, the same sk once owned by Audubon and fro which he made his famous painti of the great auk. Later, this sk served another famous painte Louis Agassiz Fuertes based l great auk painting on it.

The great auks had disappear from Funk Island. The gannets th Cartier reported were gone. Wh the Norwegian Peter Stuvitz visit the island in 1841, only arctic a common terns were abundant, a in 1874 Prof. John Milne fou terns so numerous that "we were most everywhere in danger of s ting our feet upon the eggs." Fr erick A. Lucas of the U.S. Nation Museum, visiting the island 1887, found arctic terns numero but the common terns had d appeared, and since 1953 no ter at all have nested on the island.

When Lucas visited Funk Isla

Zooming in for a rest fro feeding and brooding chor this murre joins others wl are "off-duty

In a noisy greeting ceremony, a mated pair of gannets rub bills when one returns from a trip for food.

found birds, apart from terns,
ly in "insignificant numbers."
it slowly at first, and with spec-
ular speed recently, birds have
ccupied Funk Island. Kittiwakes,
zor-billed auks, and puffins are
w common. In 1936, seven gan-
t pairs nested on the island. Now
ir colony numbers 3,000 pairs.
st dramatic has been the in-
ase of common murres: 10,000
irs in 1936, 15,000 pairs in 1945,
,000 pairs in 1952, 150,000 pairs
1956, 400,000 pairs in 1958,
,000 pairs in 1959. Today more
n 1,500,000 common murres
wd together on the smooth,
nded granitic rock of the island.
The word *funk* comes from Old
glish meaning "evil odor or vapor." One can smell the island from afar, a sharp, pungent smell of nitrate and phosphate. It has been estimated that at least 100 tons of bird excrement are dumped on Funk Island daily during the breeding season. The climate is too moist to permit the formation of guano. Rains wash it off the island and for miles around, the sea is a murky gray. This rich fertilizer produces a prodigious growth of phytoplankton, a corresponding wealth of planktonic animals, and a host of fishes, the most numerous of which are capelin. About 30,000 tons of these fish are eaten by Funk Island's birds during the four months they spend there.

As the dory from the ship brings you ashore, you jump from the heaving boat onto a narrow ledge, called now, as centuries ago, "The Bench," and your hands claw into

holds in the rock—the same ledge, the same handholds used by the Eskimos, Indians, Basques, Bretons, Spaniards, and Portuguese, by Cartier and Sir Humphrey Gilbert, for here is the best and usually the only place to land. Murres whirl around, bullet-shaped bodies with narrow rapid wings hurtling through the air, tens of thousands rushing past with the sound of a great storm.

Once on the island, the mighty chorus of a million murres stuns you with an almost physical force. In groups covering acres, murres stand shoulder to shoulder, a restless, changing pattern of black and white, like a living, moving piece of op-art. Older, experienced birds crowd together in the colonies' centers, while young birds brood their eggs in peripheral areas where breeding success is minimal. The raucous "arrg, arrg, arrg" of the adults blends with the shrill, insistent, ceaseless cheeping of the chicks into a crescendo that becomes strangely hypnotic after you have been on the island for a while.

Pools of water fill depressions, some a poisonous-looking green, others a strange magenta red. Dead murres float in the putrid water. Thousandfold death is everywhere, and millionfold life. Nearly a third of all eggs laid are buried in the thick slime of bird droppings or become glued to the rocks. Young murres, their feathers smeared, struggle pathetically through the muck.

Murres carrying capelins return from the sea in endless streams, and in this mass of more than a million birds, each one unerringly finds its mate or chick.

One must walk slowly, cautiously, on this island carpeted with birds. The murres show little fear if approached carefully, but a sudden motion will frighten them. A shock wave of movement ripples through the packed mass of birds, and a cascade of eggs splatters down the slopes. Crippled birds hide in rock clefts. Chicks struggle feebly in fissures half-filled with the partially decayed corpses of other chicks.

Already vast, the colonies continue to expand each year, spilling down into Indian Gulch, a depression at the island's north end. Here, according to fishermen's lore, an Indian bark canoe was found long ago. Even now, in the gravel at the bottom of the troughlike gulch, one can find stone spearheads left by the Indians and ancient hand-forged nails and tools lost long ago by European fishermen.

About a fifth of the island is now covered by a one- to three-foot layer of soil, and puffins tunnel their nest burrows into it. Looking closely at what the puffins dig up, one notices it is full of bones. It is not earth. It is the decomposed bodies of millions of auks: the cradle of the puffins is the graveyard of the great auk. A blanket of plants and grasses—knotweed, wild celery, curled dock, beach plantain, and scurvy grass—covers the vast charnel heap.

The auk pounds have collapsed. Some of the stones were used to build a cairn, since covered with mosses and lichen. The earth is honeycombed with the burrows of puffins. "Little resurrectionists," Dr. Lucas called them.

Few people come to Funk Island; twenty, perhaps, have visited it within the last 100 years. Only one person knows the remote island well, Dr. Leslie M. Tuck of the Canadian Wildlife Service, Canada's foremost authority on seabirds. Once he spent 21 days alone on the island, earning the awed respect of local fishermen. For they fear "the Funks" (as they call the island), where the great auk once lived and where innumerable ships have perished on treacherous shoals.

Funk Island is a sanctuary now, home to nearly two million seabirds. But of the great auk, only the mounds of its moldering bones remain, sad witness to the rapaciousness of man, a cemetery within a sea of life.

These Atlantic puffins idle a moment before resuming the work of raising young. The rock is covered with a nitrophytic lichen, which thrives on bird droppings.

THE DURABLE SNAPPING TURTLE

ter his precarious
early years,
is ancient reptile
leads such
a successful life
at he may be one
f the few animals
to regularly
reach senility

y Donald A. Hammer

When the first rays of June sunlight filter thinly through narrow shoots of cattails and bulrushes to touch the greenish waters of Lacreek National Wildlife Refuge, the resultant fury of activity seems to compress the events of creation into a few breathtaking moments. Blackbirds warble from their bulrush roosts. Gulls depart raucously to breakfast in nearby fields. Three blue-winged teal drakes twist and wheel through the misty sky as they pursue a hen in an aerial courtship above this South Dakota marshland.

Hidden in the rushes near the marsh shore, a hen mallard cackles a crescendo of brisk, descending notes. A bullfrog, after a night of booming at the stars, settles silently as the rising sun warms the waters around him. The marsh plants, dormant all winter, seem to turn green and grow before my eyes when the spring sun touches them.

On this spring day I am waiting for a particular animal, certain that it will appear soon, as it has each spring for millions of years—long before man inhabited the earth. The water stirs in the shallows near the shore, and then slowly, like a prehistoric moss-covered island rising in an ancient sea, the broad, algae-covered carapace of a large female snapping turtle rises out of the water. Laden with some 75 eggs, driven by urges that have ruled her species for eons, she lumbers onto the land in search of a nesting site.

The common snapping turtle (*Chelydra serpentina serpentina*) is the most widely distributed North American turtle and occurs in any suitable habitat east of the Rocky Mountains, including southern Canada and northern Florida.

The snapping turtle is appropriately named because of its typical striking behavior during normal feeding activities and whenever threatened on land. Rarely reaching deliberately for an object, whether a food item or a branch, snappers characteristically lunge and strike with alarming speed. Food is tenaciously held by the jaws while the long claws on the forelegs reduce it to bite-sized pieces. Even a developed embryo, exposed by rupturing an egg, displays a snapping ability.

Because of its undiscriminating food preferences, the snapping turtle often arouses the ire of man. Many a successful fisherman has pulled out an empty stringer after a visit by this submarine marauder. And countless farmers, trying to raise ducks in a pasture stream, have cursed, shot at, or tried to trap the unwelcome guest.

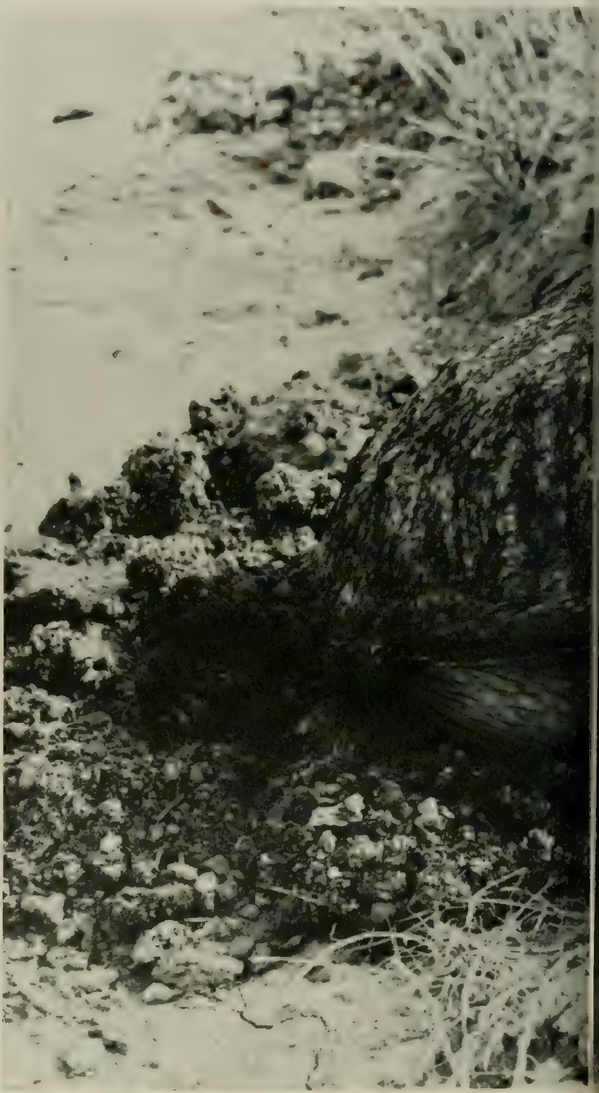
Aquatic vegetation and fish—primarily stunted panfish—are the major items in a snapper's diet. Waterfowl and snails may also be important foods. But a list of a snapper's stomach contents includes almost anything found in or near a marsh, lake, or stream. Even smaller turtles fall prey to large snappers. Snapping turtles are true opportunists and will consume almost anything edible that chance offers.

Farmers and fishermen occasionally shoot a marauding turtle. Commercial trappers, supplying demands for turtle soup and roast turtle, employ more ingenious methods. One of the simplest of these derives from the animal's reaction to loud sounds. The trapper wades or paddles into a likely location, then claps his hands or strikes his paddle against the canoe. Turtles within 75 to 100 yards react by protruding their heads above water. Upon sighting a human, they submerge immediately, but remain on the bottom in the vicinity. By probing with either a long hooked rod or with his feet, a trapper can find the turtle and pull it out. Some trappers merely reach underwater and grasp the tail, but only after ascertaining the location of the head. (Despite reports to the contrary, snapping turtles are generally docile. Stepping on a submerged snapper does not result in a loss of toes. The turtle merely withdraws its head, legs, and tail below the protective margins of the shell. Grasping a snapper's tail underwater results only in its violent efforts to escape. On the other hand, disturbing a snapping turtle on dry land produces immediate defensive behavior since escape is impossible.)

Other commercial operators use rods to probe beneath logs, muskrat houses, and similar areas. Barrel-shaped traps of woven wire baited with almost any kind of meat, either fresh or foul, are also used to capture snapping turtles. Combinations of these methods have greatly reduced turtle populations in many areas.

Tales of huge snapping turtles are common and probably based on fact. A turtle weighing 68 pounds was captured in a small lake on Valentine National Wildlife Refuge in Nebraska. After spending two months in a swill barrel, one captive snapper weighed 86 pounds. Weights of more than 40 pounds have been recorded on the Lacreek National Wildlife Refuge in South Dakota. But 80 percent of all adults weigh between 10 and 20 p

Snapping turtles are mo
quently found in the shallo
ter—two to six feet deep—
margins and permanent m
But meandering streams and
also have resident turtle
lations. The extensive beds
mergent vegetation characteri
marshes and quiet lakes,
aquatic plants provide cover



In June, a snapping turtle digs a nest for her eggs at the edge of an unpaved road in South Dakota.

ood. make them preferred habi-
Stumps and branches protrud-
above the surface enable snap-
turtles to poke the tips of their
ls above water for a quick
th and a look around without
g noticed. Indeed, it is difficult
listinguish a snapper's head.
after the "dead branch" sud-
and silently submerges do
realize that it was a turtle.

Territoriality has been suggested for this species, but data from movement studies cast doubt upon this thesis. Marked turtles appeared to move randomly within each subdivision of the Lacreek marsh, with little evidence of territorial defense. On one occasion in early June two large males engaged in a struggle. Aggressive actions consisted of biting the opponent and attempting to tear out chunks of flesh by prying with the front legs. Both turtles were bleeding profusely when discovered. They were so oblivious to their surroundings that both were easily captured when the fight drifted close to shore. Haphazard individual movement in search of food would seem to result in numerous encounters between the many turtles inhabiting each pool. Yet, this is the only observation of intraspecific aggression at Lacreek, and few instances have been reported from other localities.

Recapturing marked individuals provided information on the numbers of turtles in the Lacreek marsh. The mature turtle population was estimated at 2,500 individuals, or roughly one turtle per two acres of marsh. This figure, however, may be low, for control measures in practice until two years before the study began had removed large numbers of turtles from the marsh. Lagler estimated the snapping turtle populations in two Michigan lakes at two turtles per surface acre.

Because a turtle remains submerged for most of its life, its rough carapace provides a suitable substrate for various species of algae. These small plants have an essentially symbiotic relationship with the turtle, for whom they provide camouflage. Portions of the turtle's algae-laden carapace protruding above the surface are commonly mistaken for moss-covered rocks. Since snapping turtles rarely sunbathe, the algae are not dehydrated and killed, and algal growths accumulate from year to year.

Fossil evidence suggests that the basic turtle shell developed almost 200 million years ago. Early turtles were probably adapted to marsh environments, a condition reflected in the morphology and habitat preferences of modern snapping turtles. While their relatives experimented with almost everything from [illegible] to tremendous bulk, turtles have changed little over the eons. Typical boxlike turtles watched the rise and demise of the dinosaurs, the development of the insects, and the proliferation of the mammals. Snapping turtles are one of the most primitive, unchanged groups within their ancient order.

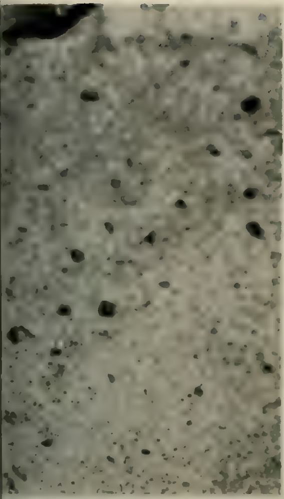
During the winter months snapping turtles hibernate in bottom muds, frequently beneath muskrat houses and logs. Respiration must be carried out via gas exchange between the turtle's tissue and the surrounding water. However, the exchange organs or tissues have not been identified. Regardless of the organ involved, the turtle's metabolism is greatly lowered during hibernation. Only small amounts of oxygen are necessary for survival.

Shortly after the ice cover thaws, snapping turtles reappear and may even emerge from the water. Occasionally a turtle will sunbathe on a muskrat house or log in early spring to raise its body temperature and its metabolic rates.

The mating season probably occurs in spring, although little is actually known of the snapper's sex life. One observer claimed that snapping turtles mate throughout the growing season, but others feel that mating occurs prior to the nesting season in mid-June.

Controversy also exists over the method of copulation. Some investigators claim the female is inverted, floating in the water while the male is erect and on top of her. My observations indicate that both sexes generally remain erect. The male curves his tail down and around the female's to allow for transport of sperm through his open, troughlike penis into the female's cloaca. During observed matings, which always took place in the water, the male usually subdued the female by grasping her loose neck skin with his jaws and holding her motionless.

Nesting occurs in June in South Dakota and slightly earlier farther



When fall rains soften the soil, hatchlings dig out and then scramble toward open vistas, seeking out aquatic habitats.

south. A few large females emerge and begin searching for sites about June 9, but most nesting activity does not occur until sometime between June 12 and 20, depending on the weather. Most females appear to be physiologically prepared to lay eggs after June 9. While some find nest sites and deposit eggs with little regard to weather conditions, most females approach marsh shorelines or migrate up small streams and then wait for favorable weather. Night air temperatures above 45 degrees appear to be a minimum requirement. Nesting activity increases with rising air temperatures. The majority of females await rain showers on warm evenings before leaving the water.

While all the criteria for a good location are unknown, it is clear that nesting sites are chosen carefully. The spot must have little or no vegetation, so that direct sunlight will increase incubation temperatures. Areas of dike or road repair and fallow fields, which offer easy digging, are preferred. Many females choose the dry, compact surfaces of dirt roadways.

Test digging is common. Females often begin digging in the first denuded area encountered and then abandon the site. After walking farther inland, digging may begin anew. The entire procedure may be repeated as much as ten times before a nest is completed and egg laying commences.

Early mornings and late evenings are preferred times to begin nesting. Disturbance by predators, especially man, may be less at dawn and dusk. Avoiding temperature extremes during midday or night may also be important, since ambient air temperatures at dawn and dusk are more similar to water temperatures.

After preliminary and apparently haphazard scraping on the surface, a female uses only her back legs to dig the nest hole. She releases copious amounts of clear liquid, which softens compacted soils and aids in digging. Typical nests are flask-shaped, asymmetrical holes extending as deep as the female's legs will reach—rarely deeper than eight inches. Snapping turtle eggs are slightly smaller than a Ping Pong ball—about one and one-eighth inches in diameter. The contents impart a pinkish cast to fresh eggs. A resilient shell inhibits rupture as the egg falls into the nest. Eggs are laid at one minute intervals and fall freely into the nest without intervening soil layers. The eggshells harden after slight dehydration, although they never attain the rigidity of typical bird eggs. An average clutch consists of about 50 eggs, but large females may lay as many as 86 eggs and smaller turtles as few as 30. After depositing a complete clutch, the turtle replaces the excavated soil over the eggs and packs it with her back feet.

Incubation periods range from 70 to 120 days. The large variation is probably due to varying soil temperatures. Cool air and soils reduce metabolic rates and result in slow embryonic development.

Turtle eggs provide meals for many hungry predators. Following raccoon tracks from nest to nest along dikes and stream banks soon produces the impression that raccoons deliberately seek out nests. Foxes, skunks, coyotes, mink, and even badgers also destroy many turtle nests. Collectively, mammalian predators destroy 60 to 70 per cent of all snapping turtle nests.

Most nest destruction occurs within a day or two after the eggs

Predators, such as raccoons, dig up and eat the eggs from about two-thirds of all snapping turtle nests.

are laid, but predators are able to discover nests throughout the summer.

Hatchling snapping turtles in South Dakota emerge from the egg in September or October, aided by a small conical egg tooth, which they have in common with other reptiles and birds. Before digging out of the nest and striking off for the nearest water, they must wait until the fall rains soften the sun-baked soil above the nest. If sufficient precipitation does not occur before the onset of winter, they remain trapped in the nest. In eastern Canada and Minnesota hatchlings have survived in the nest through the winter and emerged the following spring, but the absence of a deep snow cover in the Dakotas allows freezing temperatures to penetrate the nest and kill the turtles.

Guided by a negative geotropism, hatchlings dig upward to escape the nest. After reaching the surface, they seek an open horizon in their search for aquatic habitats. While ponds and marshes provide homes for some small snapping turtles, most reported captures of immatures have taken place in small streams. They generally remain in streams until shortly before sexual maturity, when they move into larger lakes and marshes.

A snapping turtle's first four to five years of life are extremely hazardous. Mammalian and avian predators take a heavy toll before hatchlings reach the relative safety of a nearby pond or stream. Then numerous other predator species, as well as reduced locomotor ability, contribute to a high mortality. Hatchlings kept in an aquarium with six inches of water promptly drowned unless there was sufficient submergent vegetation for them to stand on. Individuals straying more than four or five inches from vegetative support were not able to reach the surface for air, nor could they return to the aquatic plants that provided shaky ladders to the surface. Any support that enables small turtles to insert their nostrils into the air is sufficient, since deep inhalation provides buoyancy and causes the body to pop corklike to the surface. In addition, small minnows and aquatic insects were too elusive for hatchlings to capture, even in one or two inches of water. During the early months of life the snapper's diet apparently consists primarily of organic debris. Four- to five-month-old turtles swam well enough to avoid drowning and to capture insects and minnows.

Hatchling snapping turtles and adults weighing ten pounds or more are frequently captured. Turtles between these sizes, however, are rarely found, even with intensive effort. Small turtles must either be secretive to avoid observation or else they occur in very low numbers. Mortality rates for young turtles seem to be extremely high, suggesting that few small turtles survive for observation or capture. Lakes, marshes, and streams are also the homes of many predators of small turtles. Herons, bitterns, gulls, muskrats, mink, raccoon, large turtles, bullfrogs, and bass, pike, and other fish probably eat the majority of the small snappers.

A small snapper is prey for almost any hungry carnivore, but once a turtle reaches four or five pounds, life is somewhat more secure. Few mammals and even fewer birds are able or willing to attack a large turtle. Opportunism is important for predation and in lakes and marshes larger turtles encounter few large mammals. Infrequent forays overland during the nesting season or drought result in encounters but little mortality. A raccoon or fox attacking a large snapper must avoid swift and painful strikes from powerful, hooked jaws while attempting to overturn the turtle. Snappers are one of the most agile turtles. A small plastron allows good mobility and an overturned snapper can rapidly right itself.

In addition to a heavy, protective shell and formidable jaws, snapping turtles have a chemical defensive weapon. Anyone who handles or disturbs a snapping turtle soon discovers a foul, musky odor ema-
nating from the turtle. Glandu
tissue in the bridge between
carapace and plastron produces
viscous, odoriferous, yellow liqu
that is extruded between the pl
tron shields.

Winter weather occasiona
causes high mortality in turtle p
ulations. Prolonged deep snow
the ice reduces the oxygen cont
of the water and almost all turt
in a pond or lake, as well as
fish, may be wiped out. Extre
cold penetrating into bottom m
may also kill hibernating turtles.

Little information on the long
ity of snapping turtles is availa
Their potential life-span is imp
sive. An adult snapper weighing
pounds was donated to the Ph
delphia Zoo in 1926. It weighed
pounds when it died 30 years la
Since this individual was proba
at least 15 to 20 years old in 19
it was approximately 45 to 50 ye
old at death. Similar records h
been compiled at other zoos.

The majority of snapping tur
in natural populations do not we
50 or 60 pounds, nor do they
as long as the captive records
dicate. The average life-span
adult snappers in nature is
likely about 25 years.

Many snapping turtles that
vive the rigors and excesses
youth may approach senility.
carapace and plastron provide
during evidence of a turtle's
long after its death, and al
all skeletons discovered are thos
large, old individuals. Impervi
to predators, supplied with a
dant food, mature snapping tu
may frequently attain old age
der natural conditions. Rare in
animals, senility may be bot
unique trait and a tribute to the d
bility of this ancient reptile.

A snapping turtle swim
surface for air. Young
are poor swimmers and may
in only six inches o

The Sahara Dese

Existing geologic evidence confirms predictions made from magnetic orientations of ancient rocks: 450 million years ago the South Pole, ice cap and all, was in what is now the Sahara

by Rhodes W. Fairbridge

Ten years ago in the central Sahara, French geologists found traces of what looked like evidence of ancient glaciers: long parallel scratches and grooves on rock surfaces. They are the same sort of grooves that can be seen today on rocks in New York City's Central Park, convincing proof of the presence of glaciers of the last Ice Age. The ice was in New York only 12,000 to 15,000 years ago. The African grooves are considerably older.

The central Sahara is one of the most desolate places on earth. At noon in summer, the rocks and sand become so hot that you can blister your hands while climbing. During the hot months, the Arabs travel only after dark. Oases are far apart, and only a mile or two fr
the life-giving springs, there is
sign of life—not a shrub, bush,
tree; and by day, not an ant o
fly. At midday, even in winter,
sun's rays burn the skin unme
fully and there is rarely a clo
Rain usually falls for only a
hours each year and disappears
stantly into the sand. Many peo
who have lived all their lives in
Sahara have never seen rain.

In the glacial formations of
Sahara, fossils characteristic o
distinct geologic age were fo
just below and just above the c
cal layers, so that they "brack
the time precisely. The groo
were made during the Upper O
vician period, about 450 mil

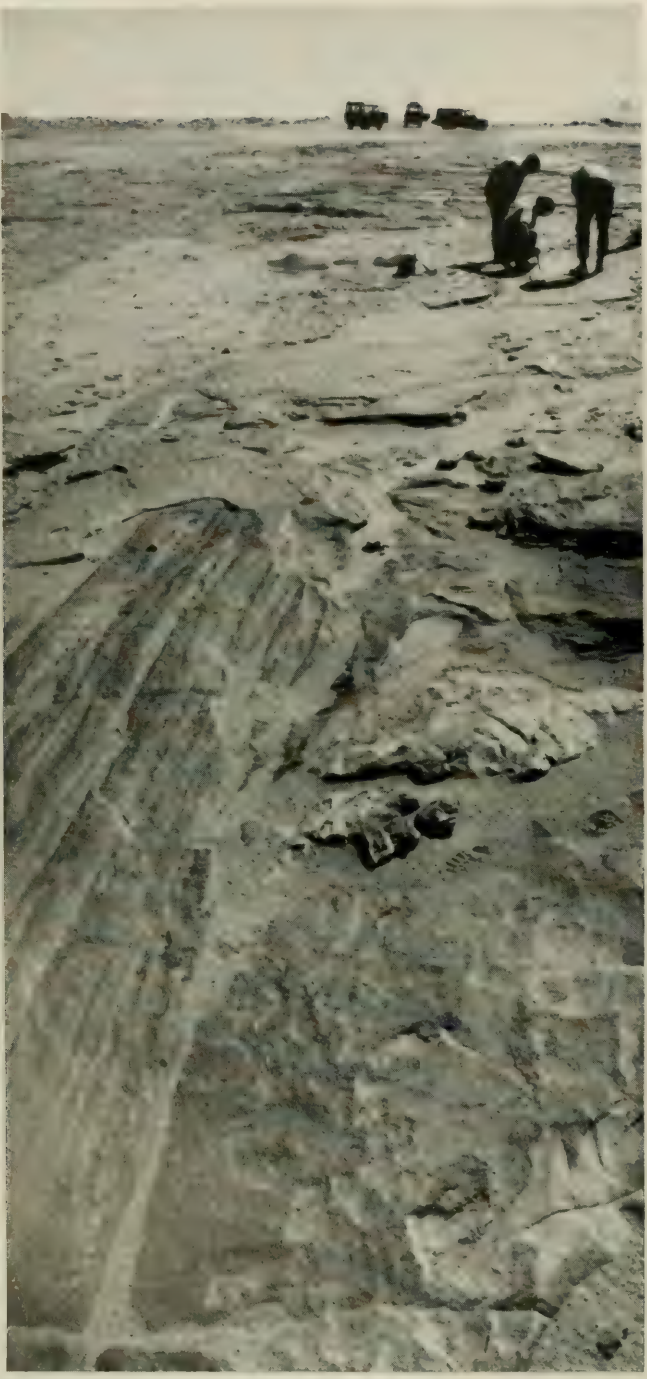
ce Cap

rs ago. And they are so exten-
, they can only have resulted
n a polar glaciation.

Vorking independently of the
nch geologists, a number of
ish and Australian geophysi-
- were exploring South America.
tralia, and other parts of Africa
bout the same time, measuring
ent magnetic orientations of
s. These paleomagnetic studies
Ordovician age rocks indicated a
position somewhere in or near
hwest Africa. So the discovery
his ancient polar area in the Sa-
was not an accident: it had
predicted by paleomagnetism.
ver the years, repeated geologic
ditions were sent into the Sa-
by the French government and
by private oil companies. Reports of similar glacial formations came in from all across North Africa—from Morocco, Mauritania, Algeria, Niger, and Chad, a spread of 3,000 miles. This could scarcely be a local phenomenon. The only acceptable theory was that it had to be a continental polar glaciation, comparable in size to that of Antarctica today.

Paleomagnetic readings in Africa indicate pole positions for about 400 to 500 million years ago in the region between the Cape Verde Islands and Morocco. If South America is brought up side by side with Africa, according to generally accepted theories of continental drift, its poles for the same period coincide almost exactly with Africa's.

Other, more traditional geologic evidence also argues for a pole position in the Sahara during the Ordovician. A decade ago a Norwegian scientist, Nils Spjeldnaes, concluded that in northern Europe the fossil faunas of this period were characteristic of warm water, while in southern Europe they were characteristic of cooler water. Careful plots of all the known contemporaneous faunas suggested that the South Pole of the time lay somewhere south of Europe, probably in west Africa. Subsequently, independent work by two other scientists, based on different fossil data as well as on the characteristics of the sediments, suggested something very similar.



Thus. both the fossils and sedi
ments of the Ordovician rocks i
northern Europe, which are tropica
in character. indicate that the near
est pole of that period lay some
where to the south of Europe.

What about the fossils and sedi
ments of the same age in Nort
America? Due to the to-and-fro mo
tions of continental drift. it seem
that eastern North America wa
closely related, although perha
not directly attached, to Europe
the time. for the belts of rocks. t
gether with their distinctive fossil
can be matched item by item b
tween Newfoundland and Irelan
The Ordovician fossils in Nort
America are widely characterize
by reef-building corals, usual
taken to be indicators of trop
seas, and by sediments that tod
are restricted to the warmer ocean
These sediments include limeston
and those deposits typical of sal
lagoons such as gypsum and ro
salt. In the Midwest, an interestin
and suggestive formation is the S
Peter Sandstone. whose sands. a
though laid down in water, sho
evidence of having been sorted a
polished by wind, and hence orig
nally a desert formation. Accordin
to paleomagnetic determinations, t
equator of Ordovician time r
diagonally across northmost E
rope, eastern North America, a
Mexico.

The French explorers argu
about ancient climates as well
geology. Geology textbooks spe
about warm seas in the Ordovicia
In upstate New York, rocks conta
fine coral reefs. Could the
dications of glaciers in the Saha
merely represent relicts of ice mov

**Geologists examine glacial
grooves in the Hoggar region
of the Sahara. The grooves
parallel the movement of the
ancient ice mass. The smaller
surface ripples, believed
formed in meltwater, are
transverse to the ice movemen**

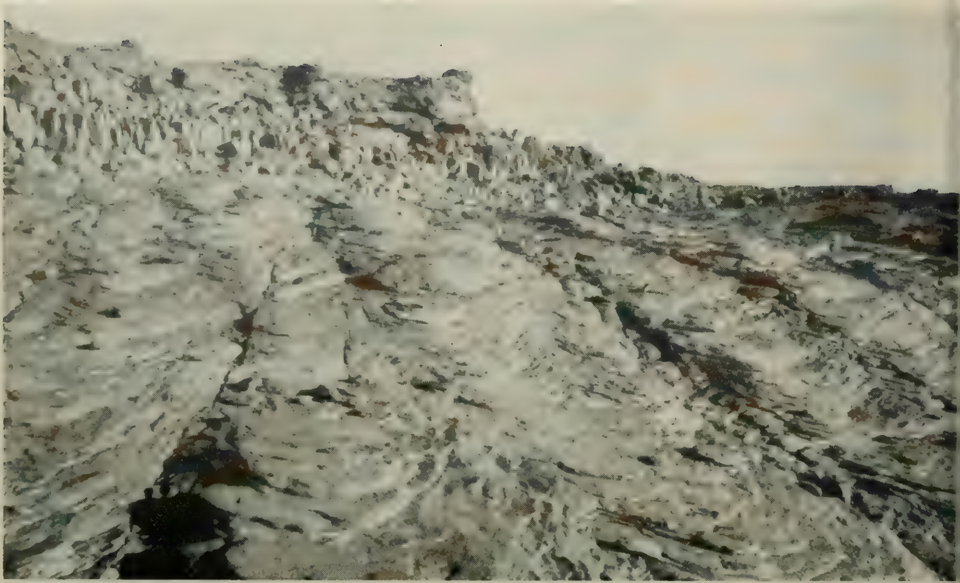
Tracks of a trilobite, a crablike creature of the Ordovician period, show clearly in sandstone.

ts in high mountains? What if
ancient Himalayan chain ex-
ed across North Africa? Some
ogists claimed that scratches
those found could have been
ned by landslides.

chance I met one of the
ich geologists in the summer of
7. He showed me pictures of the
aran evidence. Because I had
many other ancient glacial for-
ons, he asked if these looked
same. They most certainly did.
n a study of the way the pole
ed *after* the time of the glacia-
it dawned on me that this was
South Pole of the time—here in
we like to call the "Northern
isphere."

e oil companies wanted to un-
and the Saharan formation
use the porosity of oil reservoir
had to be deduced from the
e of the sediments. So in Janu-
1970, at the invitation of the
tut Algerien du Pétrole a group
xteen specialists assembled in
rs to undertake an expedition
the central Sahara that would
le us to see all the evidence.

ere, in the Tassili plateau, we
diately observed the Ordovi-
rocks to be almost flat-lying,
only very gently tilted toward
orth, so that the same forma-
can be examined and re-exam-
in countless cliffs and gorges
undreds of miles. The nucleus
is region, the Hoggar (Ahag-
r on English maps) is a wilder-
of jagged mountains con-
g of Precambrian crystalline
s, 2 billion to 600 million years
d punctuated here and there by
ely youthful basalt volcanic
Around the margins of this
ent nucleus there is an over-
p of the Ordovician rocks that
itute the famous Tassili pla-
—famous because of their re-



Giant ripples, ten feet from crest to crest, were created by powerful marine currents. It is believed the currents were produced by the decanting of millions of tons of water from the melting polar ice cap.

markable Stone Age paintings on the cliffs and caves.

The Ordovician rocks are almost exclusively sandstones and rest on the eroded upturned edges of the older Precambrian "basement." In fact, there were mountains here long ago, but they had been weathered away and reduced to a horizontal plain before the Ordovician period. A key observation was made at this point of contact. The weathered top of the Precambrian was achieved under warm, wet, tropical climatic conditions, leaving traces of a clay soil. Therefore the climate was tropical well before the glaciation.

The base of the overlaying sandstone contains ventifacts (pebbles with a distinctive wedge shape due to abrasion by desert sand). The interesting thing is that this evidence of desert erosion is not modern. It was achieved just before the Ordovician sediments were deposited. These 450-million-year-old sandstones contain abundant footprints of trilobites, a characteristic, now extinct crablike crustacean of that period. Later on we found complete specimens of trilobites, as well as of many other fossils. Furthermore, the structure of these sediments is typical of a shallow continental shelf environment. We are confident that here exists the evidence of an ancient sea, pushing in over the deeply weathered, planed-down surface of an ancient continent.

Several hundred feet above the base of the Ordovician sandstones, we came across subtle changes in the sediments. Here and there the surface of the beds showed ripple marks exactly like those that can be seen at low tide today. In places, they are impressed with the tracks of trilobites; in others by the shapes of seaweeds. Clearly we were again in a coastal setting and could conclude that the ocean was once more withdrawing. In other a the underlying sediments deeply scoured into channels tremendous currents had swept the sea floor; then the cha were refilled and covered sands containing pebbles and b ders of a strange type, evid transported from a consider distance.

Those boulders told the s Some of them were of Precamb granite and quartzite and were too big to have been rolled a the sea floor by marine curr They had to be transported by s rafting agent. Some of the boul were smoothly scraped or poli on one or more sides. Only gla do this, and only ice floes or bergs can transport large boul far from their source areas, ca ing them out to sea.

The curious-looking sandst that enclose and overlie these b der beds contain higgledy-pigg mixtures of all sorts of rock unstratified disorder. They are cal of some glacial moraines, ticularly the sandy ones of the tic. Similar rocks are kn however, to occasionally result submarine landslides. We

could well be tillites, rock
is that is the product of melt-
ice. but we needed more evi-
e to be sure.

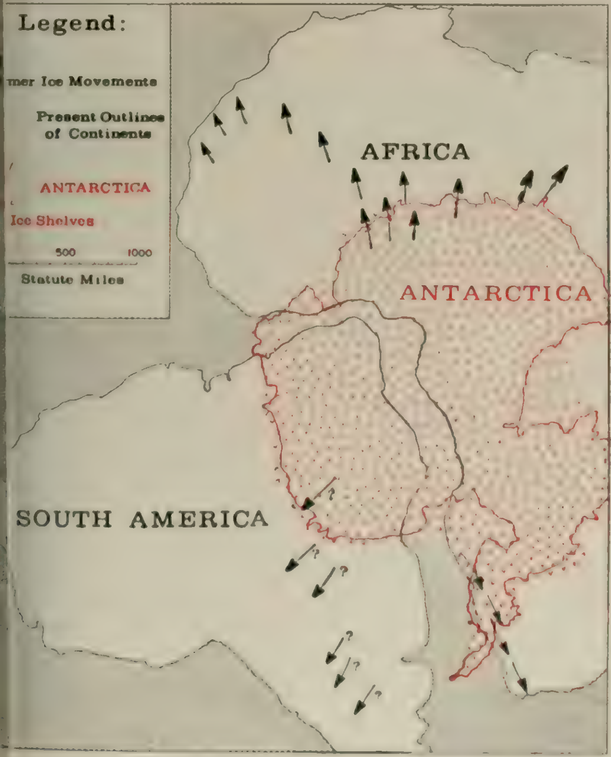
ere and there the sediment sur-
is marked by parallel lines of
ing marks, a sort of rotary
ping. This is typical of floating
which grounds on a shallow sea
turning this way and that as it
iven by the wind or tide.

e of the most extraordinary
res of the sandstones lying
and to the north of the gla-
moraines, was a belt where the
had been swept by powerful
nts into giant ripples ten feet
re from crest to crest, extend-
n a formation up to 100 feet
and stretching out for several
red miles. Giant ripples are
d by tidal currents in certain
cted areas today, such as the
ern North Sea, the Celtic Sea,
in the Strait of Malacca. But
pples in the Sahara are of vast dimensions. Could they represent the decanting of millions of tons of meltwater from the margin of the Ordovician glaciated region during the melt period? At such time, the release of the ice pressure would have permitted the earth's crust to rise rapidly to its former position. A similar spillover occurred in the Baltic after the last glaciation and likewise in Hudson Bay.

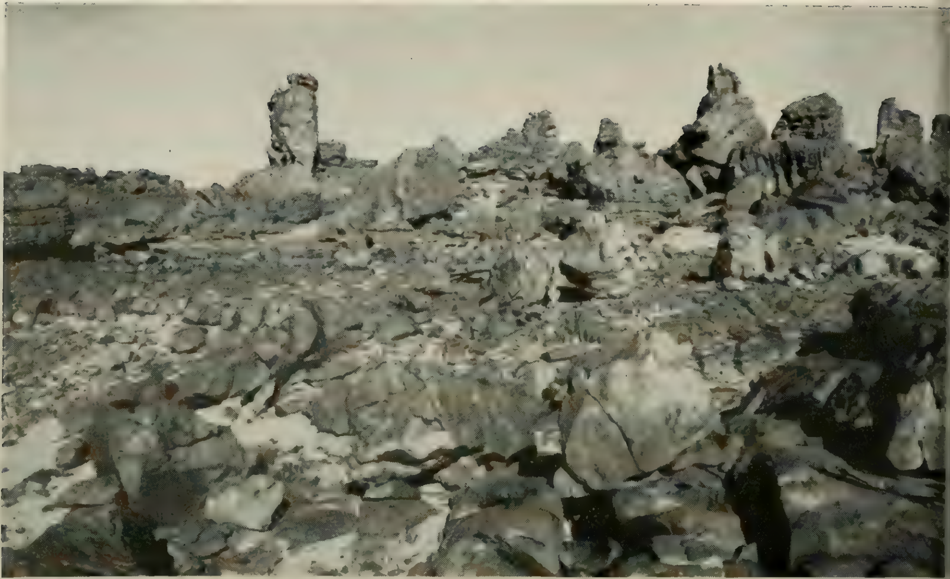
Traces of subglacial volcanoes are perhaps the most peculiar of the features not normally associated with sandstones. Eruptions commonly occur under the glaciers of Iceland today, so we have some living models. The lava rises up but is quenched by sudden contact with the ice. In the Sahara, we first saw these circular-shaped structures (about 500 to 3,000 feet across) on air photographs and thought they might be meteorite craters. But at ground level, we found that each had a core of basalt surrounded by a curious belt of fused sand and volcanic rock, like clinker, and all within a ring of the glacial sandstones forced up into a vertical position. In some places the glacial rocks and these intruding volcanic necks are overlapped by beautifully stratified shales of the Silurian age, dating from about 430 million years ago, which show no traces of ice or volcanoes. The Ice Age was definitely past.

Pierre Rognon, a French geomorphologist who had made a close study of modern glacial processes, showed us many small-scale indications of the Ordovician glaciation. Numerous outcrops revealed a maze of little vertical cracks filled with silicified sand, a positive sign of frost action; the region must have been widely affected by permafrost. There are many little spring structures, produced by meltwater being forced up by the load of nearby ice or by other hydraulic pressures also related to permafrost. They appear somewhat similar to the tundra craters and pingos found in northern Canada, Greenland, and Siberia.

Meltwaters from the Saharan glaciation carried out and laid down sand as river or tidal flat deposits. These meandering patterns are comparable with those of the out-



The continents of Africa and South America are positioned where they are believed to have been during the Ordovician period before continental drift carried them to their present locations. Magnetic and fossil evidence places the South Pole of that time in or near northwest Africa. Arrows locate glacial grooves, ice-rafted boulders, and other evidence of Ordovician glaciation. When today's south polar ice cap is superimposed (color), it covers an equivalent area.



Sediments in an ancient stream bed have eroded less than the surrounding rock, and now stand out in a landform called a ruiniform.

wash plains of Iceland today. Because the Tassili formations lie flat, it is still possible to follow these old meanders across the country; they are spectacular from the air. Here the former stream fills are best preserved and the topographic relief is reversed; the former meandering streams now stand out as long, snakelike ridges, and the sediments are silicified, jointed and weathered out into the strangest shapes. The French call it a ruiniform relief: from a distance the ridges look like ruined castles. If we could take a giant X-ray picture, which would strip away the soil and expose the ice-melting belt from the last glaciation that stretched across the United States from the Midwest to Long Island and Cape Cod, we might see a landscape very much like Tassili.

These glacial traces have been picked up all the way across northwest Africa. The North Pole at this time is known to have been somewhere in the Pacific Ocean. Just where was the South Pole of the day? There have been some scattered reports of Ordovician glaciation in Argentina and Bolivia, in southwest Africa, and near Cape Town. I have not, as yet, been able to examine and check them, but just to review the possibilities, I superimposed the present map of Antarctica on Africa, reassembled with South America (*page 71*). Assuming the climatic conditions were not colder than during the recent Ice Age, the polar glacier hypothesis could still explain this far-flung distribution in Africa. I still had to assume that the South American examples resulted from mountain (not polar) glaciers, as seems likely from the descriptions.

Another possible explanation is that the continents shifted very rapidly (with respect to the pole) during Ordovician time. Other glacial formations, for instance, of some 250 to 300 million years ago, have been found all across the Southern Hemisphere. However, even with
the help of the continental dri
construction of the countrie
volved, it is still hard to thi
such a broad area all glaciat
the same time. New research
conclusively that this more
glaciation started with the Ca
iferous period in South Am
and gradually migrated eastw
include the still more recent
mian in Australia. So we do
of another example of rapid
nental drift that might help o
dovician problem.

At this stage of the investi
we had evidence of forme
sheets in the Sahara, but noth
prove it was polar and not
tain ice. The ice could have
from mountain glaciers,
southern Alaska today. The
great day came. In the easter
of the Hoggar, in the valley
Wadi Taffassasset, we came
mile upon mile of superb
striated pavement. It was
from south-southeast to
northwest, just like some gian
dozer scraping. We trace
striated pavements on the
for miles. Later, from the a
followed them across hundr
miles of territory, and other

firmed their continuation right oss northwest Africa. We had of positive! Striated rock pave- ts of such size are found only he regions of the Antarctic ice today, or in the Canadian or ndinavian glaciated areas of the Ice Age climax.

he debate was over: we were nimous in certainty. Only a gi- continental glacier could have e this. Our expedition to North ica had confirmed that 450 mil- years ago, there had been a hty glaciation just where, more ntly, the world's record high perature of 137 degrees Fahren- in the shade had been recorded. ancient South Pole had indeed ted somewhere near what is now Sahara.

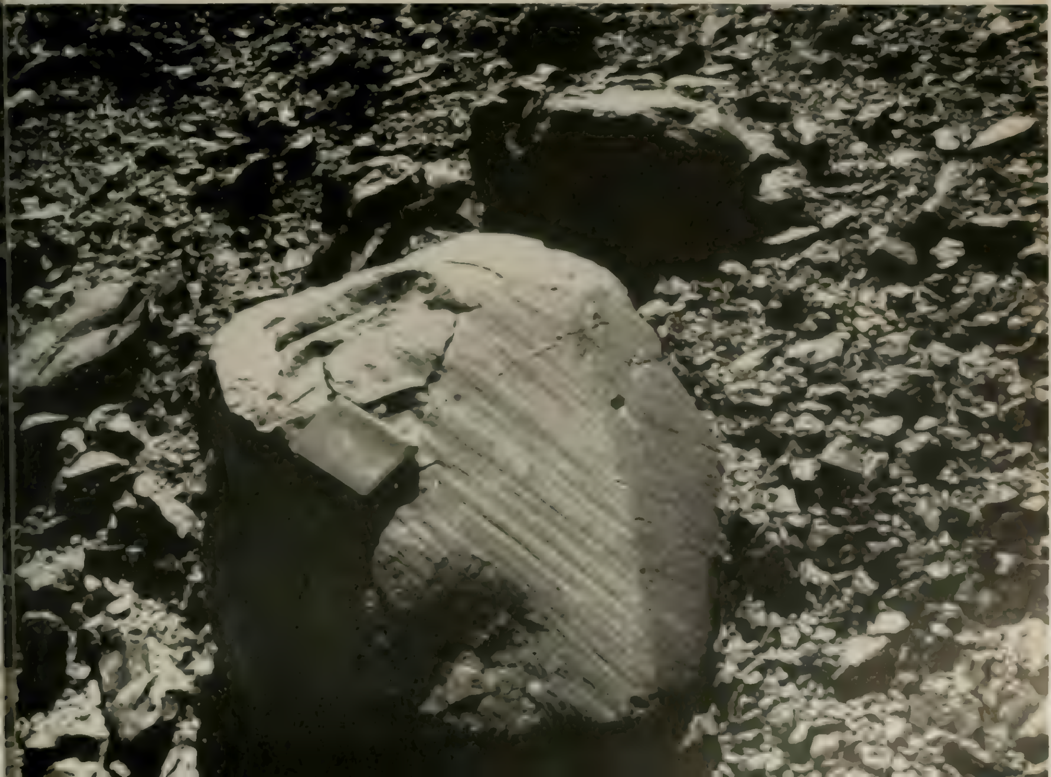
he discovery in the Sahara has revolutionized our ideas of ogy, but it has been a triumph international scientific re- ch—although largely conducted he French—and it has started a n reaction of ideas that focus ultimately on the very nature of the planet.

What is the globe doing at the present moment? Our earth, spinning in space within the gravitational field of the sun, possesses an enormous momentum. It is like a giant flywheel and accordingly, very difficult to accelerate or slow down, or to jog out of place.

The Atlantic Ocean is known to be spreading apart at one to two inches per year. The entire crust seems to be turning over, so that the Aleutians and Alaska are pressing southward toward the Pacific, while Europe seems to be setting northward. The Mediterranean may be expanding a little; it seems to have jogged to and fro for a long time. The Red Sea is certainly opening up.

The crust of the earth, however, is only a thin skin on the massive inner mantle and core. At depths of 50 to 100 miles, there is a zone of potential melting, and over this layer the crust can slide, albeit sluggishly. It now appears that the whole crust can slide, but since cracks and splits may develop in the crust (as has happened in the Atlantic Ocean), some parts move faster and farther than others. When these major slippages occur, it is probable that they set up a wobble in the pole. The poles already go through a slow variation in their angle of tilt to the orbit around the sun. A sudden shift of surface mass could give the pole quite a nudge, and would also slightly change the rate of spin. A better understanding of the past can help us learn what to expect in the future.

A huge boulder that can only have been transported by a glacier shows striations where it scraped against bedrock beneath the ice.



The Sorcerer's Apprentice

by William and Claudia Madsen

A SEPARATE REALITY: FURTHER CONVERSATIONS WITH DON JUAN, by Carlos Castaneda. *Simon and Schuster, $5.95; 195 pp.*

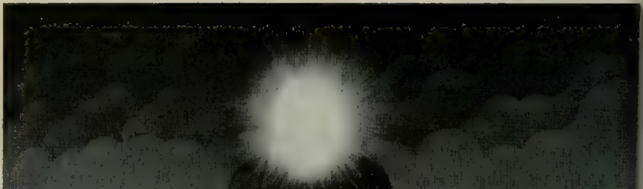
Carlos Castaneda is probably the first anthropologist to learn witchcraft from a self-proclaimed witch. His teacher was an old Yaqui Indian who sensed something special about the young university student and decided to take him on as an apprentice. In his haunting story, Castaneda draws you into the weird world of witches—a world you will never be able to explain or forget.

The story begins in an Arizona bus depot near the Mexican border where the young student and the old witch met quite by chance. At least that is how Castaneda explained his fortuitous meeting with Don Juan at the time. An Anglo friend pointed out Don Juan as an eccentric Indian who knew a lot about peyote.

After introducing himself, Castaneda explained to Don Juan that he was seeking information on peyote. All the while he noticed that the old man's eyes seemed to shine with a peculiar light of their own. His penetrating gaze embarrassed Castaneda, making him look down to avoid it; he had the feeling that the old man could see through him. Finally he gave up trying to make conversation, and the two men sat in uneasy silence until Don Juan left to catch his bus. Before departing, he invited Castaneda to come to his house sometime.

Several months later, compelled by his overwhelming curiosity about "that look," Castaneda went to see Don Juan. The more he thought about it, the more unusual it seemed. Within a year Castaneda and Don Juan had become such good friends that the old man revealed his secret identity. He made the astounding admission that he was a *brujo* (witch). This is something Indians do not ordinarily reveal; almost all Mexican Indians are afraid even to talk about witchcraft, let alone confess to practicing it, for witchcraft is considered the epitome of evil.

For reasons of his own, Don Jua decided to teach his secrets to a ma who was not a relative, not a neighbor, and not even an Indian. Castaneda's training began with the use o three hallucinogenic plants—peyot jimson weed, and a mushroom of th



"Don Juan's face looked as if someone were shining tiny mirrors on it; as the light became more intense th face lost its contours and was again an amorphous glowing object."

s *Psylocebe*. He described the
four years of his apprenticeship
he Teachings of Don Juan (Bal-
ne Books), an exciting book that
ld be read in conjunction with *A
rate Reality*.

his first book, Castaneda de-
ed Don Juan as a witch and a
rer, using the two words inter-
geably to translate the Spanish
brujo. The second book calls
Juan a sorcerer. Since it is stand-
practice to translate *brujo* as
h," we have used that word here.

distinctive characteristic of a
is his power of transformation.
staneda's first venture into the
own was a peyote trip. On this
he was to meet the great Peyote
t, the protector of Indians. If Pe-
Spirit did not like him he would
him away and that would end
arning. So said Don Juan.

ter consuming six peyote but-
Castaneda began to vomit. He
a dog drinking from its water
and suddenly the dog became
parent. At that moment Casta-
began having convulsions and
led to the water pan where he
with the dog. Then a stranger
happened. Castaneda grew a
lustrous mane and turned into a
He barked, ran, played, and
led with the other dog until they
knew each other's wishes.

en he became human again,
neda learned from Don Juan
the dog he had played with was
dog. It was Mescalito, the Pe-
Spirit, who had assumed the
of a dog. Mescalito had played
Castaneda because he liked him.
s a good sign.

terward, Castaneda experienced
und melancholy. Peyote had
ced in him an undefined fear,
he told Don Juan he did not
another encounter with Mesca-

QUESTAR SPIES ON A BALD EAGLE

— brooding on his fate, perhaps, as he surveys his dwindling domain?

The photographs were taken by Ralph L. Shook on a bitter cold day in February, with the wind at 15 miles per hour. He spent many hours waiting for his eagle to visit this favorite perch. The picture at the right shows the whole scene with his Kodak Instamatic — his Field Model Questar set up in a blind, 150 feet from the bird's tree. His modified Nikon with through-the-lens meter is close-coupled to the telescope and the arrow points to the empty branch. Above, the Questar photograph is cropped from an 8 x 10 enlargement of 35 mm. Tri-X, taken at f/16, 1/250 second.

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lito. That was when he learned t he had no choice in the matter—M calito had chosen him to learn I Juan's secrets and he could not fuse.

The next step was learning the crets of the jimson weed, *yerba diablo* ("devil's weed") in Span Those who use it are called diable The Indians of Sonora describe diablero as an evil person who ca sickness and death and has the po to transform himself into an ani This is the universal image o witch.

Not just anybody can becom diablero. He must have certain in qualities. According to Don Juan, diablero has a passionate, vola and ambitious nature. He is a cl of darkness with a natural affinity night animals. In the old days a d lero could prowl by night in the f of a wildcat or a mountain lion. day such powerful men have all disappeared from the world. T diableros only become birds, dogs other small animals. Don Juan c become a crow but he had abando the devil's weed when he lost youthful lust for the power to des his enemies.

He felt that Castaneda was a well suited to the devil's weed. had an ambitious nature and he passionately fond of the darkr But there was a more important son. Don Juan sensed that Castar had the innate power to see th that ordinary people cannot see.

To find out whether the de weed would accept him, Castar had to drink a concoction made f the root. It smelled like cockroac As soon as he swallowed it, he be to sweat and blood rushed to his He got painful stomach cramps saw a red spot in front of his An uncontrollable nervousness s over him in waves, making his chatter. At last he fell asleep slept for two days.

When he awoke, Don Juan him the ordeal had been a success cause he had seen red spots. T who see red have a strong and vi nature—something the devil's likes. A man who sees black spo not made for the devil's weed. Juan warned his pupil that the s of the devil's weed is like a posse woman. Men end up as her slave return for the power she gives t Asked if he liked her, Castaneda plied that he felt a strange new vi He felt as if he could demolis wall.

Two years after beginning training, Castaneda started to fly. big day dawned sunny and clea sign that the devil's weed liked

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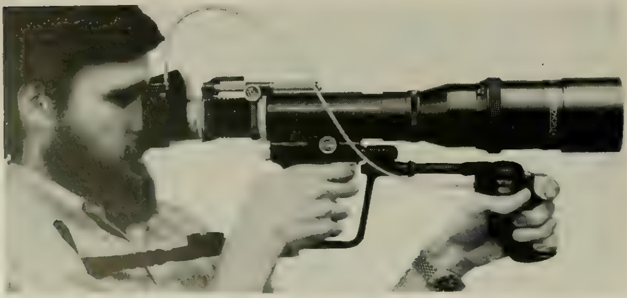

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new man. He gulped a devilish br
slumped back, and gasped for brea
Don Juan ordered him to take off
clothes. He obeyed. Still following
ders, he rubbed his body with a pa
made from the devil's weed. He to
a step forward and his legs were l
rubber. He moved forward again a
up. And then he soared into the s
His speed was extraordinary. He
he had found the place where he
longed—the darkness of the nig
Later he flew in the form of a crow.

Castaneda's training, which had
gun in Arizona, shifted to Son
Mexico, when Don Juan moved th
Sonora was the setting for his
vanced course, which dealt with
power to see. A witch sees all sort
things that ordinary people do
see. For example, he may see that
bird on his roof is not a bird, bu
witch in the guise of a bird. He
see that the stranger he just met
witch, for a witch's eyes are diffe
from the eyes of ordinary men. T
have the peculiar glow that Castan
had noticed in Don Juan's eyes w
they first met.

A witch must see to defend him
from other witches and to fin
spirit ally who will help him des
his enemies. Castaneda had the i
power to see but was unable to us
Don Juan could see why. The po
was plugged up by reasoning. E
thing Castaneda looked at was
torted by his ceaseless effort to
plain things in terms of a preconce
notion of reality.

The only solution was to smok
pipe mixture made with halluc
genic mushrooms. Don Juan clai
the spirit of the smoke would
Castaneda see. It could even take
to the other world where the spiri
lies live. Before smoking, Casta
was told he would encounter
guardian of the other world. A
he saw only a gnat. Then sudden
saw a gigantic, drooling monster
bulging eyes and a long muzzle.
beast beat its wings and circle
front of him, coming closer
closer until the wings hit him.
excruciating pain caused Casta
to yell with all his might.

By far the most extraordinary
perience was one not directly
nected with the use of drugs. It b
when Don Juan fell and dislo
his ankle. The fall was no accide
witch called la Catalina made
Juan fall because she was tryin
kill him. Don Juan announced th
would soon be dead unless Casta
was willing to help save his life.

That night Don Juan locked
self in his house while Casta
waited outside with a shotgun f
Catalina. After awhile she lande

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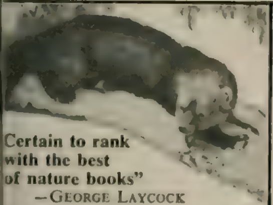

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the roof in the form of a blackbird. Castaneda fired his gun at the bird and heard a horrendous human shriek. A search for the dead bird failed to produce so much as a feather. Lacking a corpus delicti, Don Juan was forced to conclude that Castaneda had failed to stop his enemy. Now she would be itching for revenge.

There was only one way to stop her. Castaneda would have to stab the woman in her navel with a wild boar hoof. In the morning Don Juan and his apprentice set out on their bizarre errand. They waited on the side of the highway where la Catalina was expected to appear. Suddenly Don Juan pointed to a woman walking across the field toward the highway. Castaneda ran after her and actually tried to stab her. She brushed by him so fast that the boar hoof missed its aim. He turned and saw her standing on the other side of the road smiling at him.

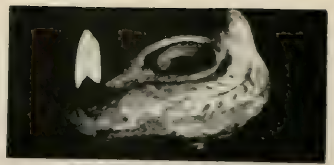
When Castaneda saw three or four men hurrying toward him he got away as fast as he could. Back home Don Juan confessed he had tricked him into believing his life was in danger. He said it was true that la Catalina had tried to kill him, but she did not have enough power to do so. Now she would turn on Castaneda. Therefore, the reluctant Castaneda would have to practice witchcraft to defend himself. It was a case of do or die.

The dramatic impact of Castaneda's books is tremendous. You have to read them yourself to savor the poignant quality of his writing. Somehow he makes his fantastic experiences sound perfectly plausible and deeply moving.

Although other anthropological studies describe cultural beliefs about witchcraft, they do not tell us how it actually feels to be a witch. Castaneda's work is unique because it reveals an inside view of how witchcraft works. We learn from Don Juan that the witch receives his power from spirits who may be reached through drugs.

This view of witchcraft raises an important question: Do Indian witches generally rely on drugs? Scattered reports suggest that drug use may be fairly common among witches in Oaxaca, Jalisco, and Sonora. It would not be surprising since peyote has been widely used in ancient religious ceremonies still practiced by the Huichol Indians of northern Mexico. Under the influence of peyote, the Huicholes see exactly what their culture teaches them to see. They see gods.

In the same manner, Castaneda saw what his teacher instructed him to



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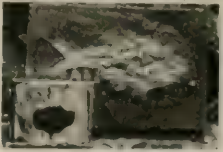

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see. Before each trip he was carefully briefed about the kind of spirit he would encounter, and afterward his visions were interpreted by Don Juan. Thus the entire experience was skillfully manipulated through the power of suggestion.

Castaneda's work, however, cannot be judged as ethnography because it is not placed in cultural context. He does not actually describe the Yaqui Indian way of life or the Yaqui philosophy of life. Rather he gives a subjective account of his relationship with a man who, although he was a Yaqui, did not belong to the Yaqui community, and was feared by them. Don Juan had left home at an early age and had lived in many parts of Mexico. Hence his thinking could have been influenced by mestizos who are not primitives.

It is unfortunate that Castaneda does not provide any anthropological framework for his material. Anthropology traditionally deals with shared beliefs, but Castaneda does not. He describes one man's reality without showing whether it is shared by any group of people, primitive or otherwise. Until Castaneda finds out whose reality he has discovered, the significance of his work remains obscure.

William Madsen is professor of anthropology at the University of California, Santa Barbara, and has written numerous books on Mexican cultures. Claudia Madsen has written a book on Mexican folk medicine and coauthored several articles with her husband.

AN ARTIST IN AFRICA, by David Shepherd. *Charles Scribner's Sons, $15.00; unpaged, illus.* AN ARTIST'S SAFARI, by Ralph Thompson. *E. P. Dutton & Co., $19.50; unpaged, illus.*

In reviewing books of this kind, one has to be more than usually careful to distinguish between personal predilection and dispassionate judgment. These are both art books and books of natural history, and therefore must be judged for revealed truth as well as for the esthetic experience.

David Shepherd is an artist of the first rank. I would be inclined to agree with Nigel Sitwell's statement in the introduction to the book that Shepherd is the foremost painter of African wildlife today. This is the first published collection of his paintings, and all who delight in depictions of animal life will welcome its appearance. Shepherd's success in combining the two functions inherent in such an art form is remarkable. These are paintings that can be en-

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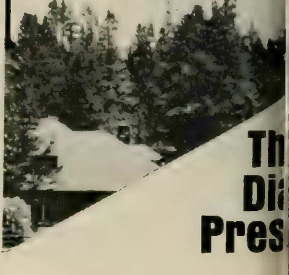

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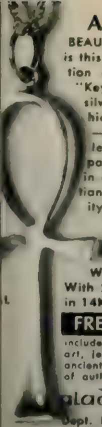

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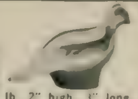

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joyed both as works of art and as a statement of things observed and recorded. The book is well laid out and, with one or two exceptions, the reproductions are excellent.

It is more difficult to assess the intention of Ralph Thompson's big and lavish book. In the form of an enlarged sketchpad, it is filled with lively black-and-white sketches of wildlife, interspersed with watercolors of equally sketchy charm. It is, indeed, in the tradition of the eighteenth- or nineteenth-century Grand Tour sketchbook. Is the artist justified in claiming for these sketches, as he does in his introduction, that they "form a language of their own"? They do not for me, although I find them likable. The less ambitious pictures are the best, for in some of the larger watercolors, sentimental eyes, smiles, and flirtatious looks often clash with revealed truth. Too many of the animals are cuddly.

The publisher's jacket blurb states that "these brilliant sketches and full color paintings portray what no photograph could ever do—not only magnificent vistas and the majesty of wildlife in its natural surroundings but something closer to the heart of the continent itself, the rhythms and patterns of life which have remained unchanged for thousands of years." This is puffery of the highest order.

Make no mistake: this is a good sketchbook and if you like the artist's style and are interested in the subject matter, you will find it a rewarding possession. Despite the publisher's advice, I will continue to gain knowledge and pleasure from photographs of masters of the genre, like Emil Schulthess. In addition, I can now refer to Shepherd's *An Artist in Africa.*

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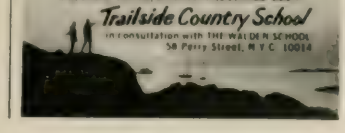

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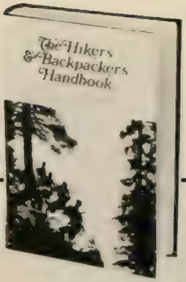

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The Murres. L. M. Tuck. T Queen's Printer for Canada, tawa, 1960.

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Continental Drift. J. T. Wil *Scientific American*, April, 1963.

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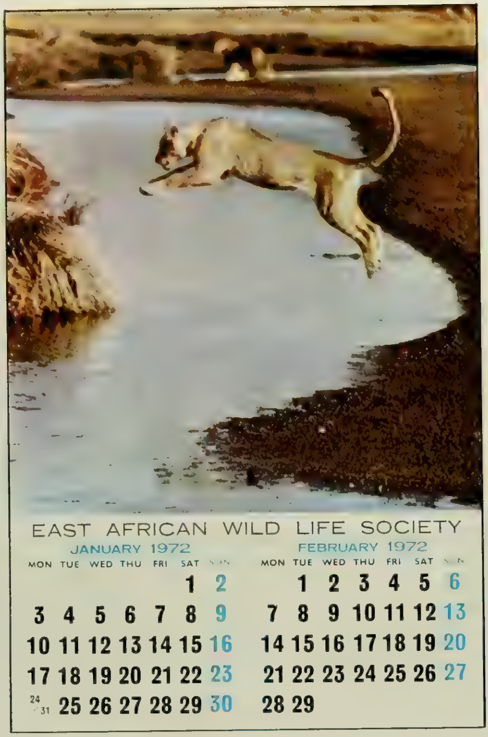

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24/31	25	26	27	28	29	30

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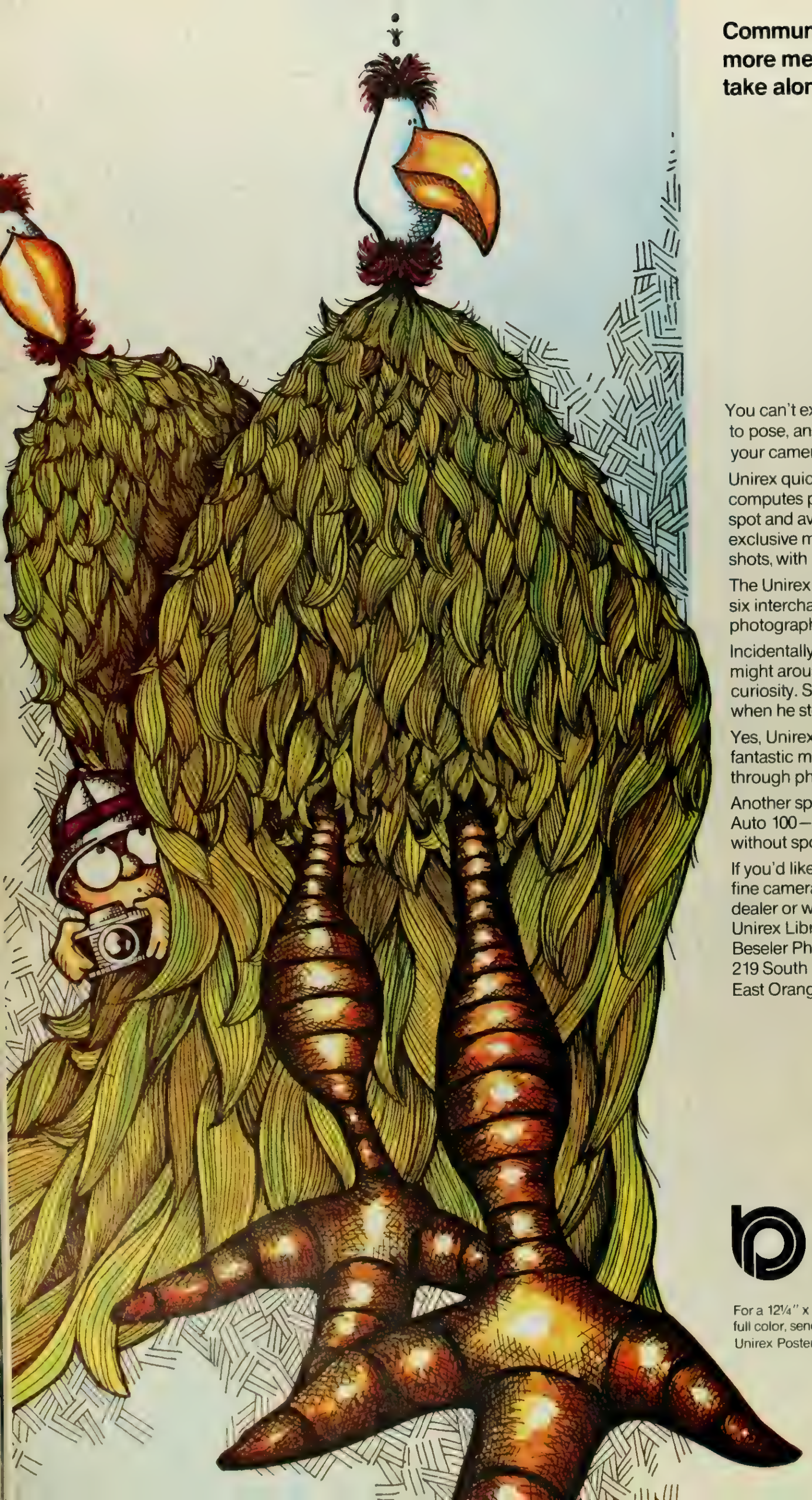

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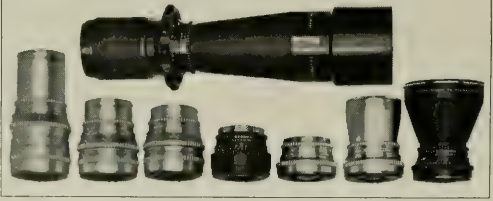

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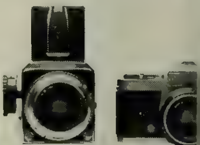

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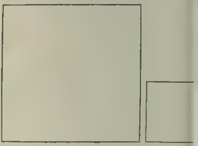

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82 DIGGING SHANIDAR
A review by C. Loring Brace
Although written with the sometimes annoying terseness of an Old West cowpoke, a "hard-nosed dirt archeologist's" account of the Neanderthal discoveries in Iraq is a "corking good adventure story."

96 SUGGESTED ADDITIONAL READING

COVER: *The intimate relationship between this emperor sea bass and the other organisms that share the New Caledonia reef reflects an ancient tendency of life.*

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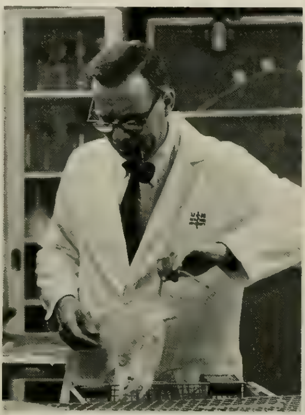
Authors

As an active member of the Explorers Club, **Louis C. Whiton** has led six expeditions to Surinam to study the Bush Negroes. Having undergone a voodoo cure on one of these trips, he plans further study of voodoo ceremonies in Haiti later this year. Whiton, a retired businessman, has served as a lecturer at Florida Presbyterian College and Rollins College. He earned a Ph.B. in engineering from Yale University, and an M.A. from Columbia.

The dimension of time pervades man's perception of the basic rhythms of life and must be considered when dealing with ecological problems contends **Robert Sommer,** this month's Naturalist at Large. In a study of bikeways as part of a mixed transportation system, Sommer, chairman of the psychology department at the University of California at Davis, has been interviewing some of the estimated 20,000 cyclists in the area. The study is scheduled to be released soon. Sommer wrote "People's Art," in the February, 1971, issue of Natural History Magazine.

Not long after buying a house on Cape Cod, **Lewis Thomas** was, predictably, into the water scene of the area, but not for typical summer recreation. After years of research in experimental pathology, with an emphasis upon the complex adaptive aspects of inflammation, Thomas began investigating the intricate relationships of defense mechanisms in man and animals, including the rich fauna of the sea. Thomas, professor and chairman of the Department of Pathology at Yale University, is on the board of directors of the Public Health Research Institute and was a member of the President's Science Advisory Committee from 1967 to 1970. He obtained his M.D. from Harvard University.



Fresh from receiving the Hal
Honor Award from the I
national Underwater Film Fes
in Santa Monica, where he
served as a lecturer, **Dou**
Faulkner is off on a six-m
photographic expedition to
Palau Islands. His photogr
were recently shown at the Nei
Gallery in New York, and he
chosen as one of the lecturers a
Second Concerned Photogra
Lecture Series held at New
University last year. Faulk
work illustrated the article "C
in the March, 1971, Natural
tory Magazine.

An American husband and wife team of research officers at the Animal Behaviour Research Group of Oxford University, **Barbara R.** and **Michael H. MacRoberts** plan to return to the United States in October to begin a three-year study of
acorn woodpeckers at the Has
Natural History Reservatio
Carmel Valley, California.
previous field work has taken
to Gibraltar, where they studie
famous Barbary apes, and to
ney Island, England, where th

ched the breeding, territorial avior, and communication of ing and lesser black-backed s. Some results of that project e reported in "The Gulls of ney Island," NATURAL HISTORY AZINE, March, 1970. Barbara Roberts received a master's de- in physical anthropology from University of California at Ber- y, where Michael MacRoberts ined a Ph.D., also in physical ropology.

s part of his archeological field k. **Eric Ekholm** has spent e than three years tracing the and times of a tavern where ers met to enjoy "good flip, toddy." He carried out the of the shoveling and sifting led to the discovery of the ing tavern at Wellfleet. A re- h associate at Plimoth Plan- n, a re-creation of the original im village in Plymouth, Mas- setts. Ekholm is pursuing uate studies in anthropology at n University, where he pre- ly earned a bachelor's degree. ast field work has taken him to huacán in Mexico and Tikal, emala, but further work on the en site will keep him anchored llfleet for a while.

Jmes Deetz, coauthor of llfleet Tavern," also participated e dig of the tavern site last summer, the latest of a number he has worked on in the New England area as he tries to piece together the history of colonial America. His archeological explorations have also taken him to the Great Plains of South Dakota and to California. Deetz, who received his doctorate in anthropology from Harvard University, is assistant director of Plimoth Plantation and professor of anthropology at Brown University. He coauthored "Death's Head, Cherub, Urn and Willow" in the March, 1967, issue of NATURAL HISTORY MAGAZINE and wrote "the Reality of the Pilgrim Fathers" for the November, 1969, issue.

Sigurdur Thorarinsson, who has studied and admired volcanoes for many years, finds their perfection of form comparable to that of a Norwegian Viking ship or a Stradivarius violin. Director of the Division of Geosciences of the University of Iceland, Thorarinsson developed a method to identify and date ash layers deposited from past volcanic eruptions. He calls this method tephrochronology, now an internationally accepted term. Thorarinsson has studied glaciers in Iceland, Swedish Lapland, Japan, Mexico, Hawaii, and Alaska. Born in Vopnafjördur, Thorarinsson received his doctorate from the University of Iceland. His specific interest in Mount Hekla began while studying its extensive tephra layers, particularly following the big eruption of 1947. As to his continuing interest in Hekla, he says, "I like that damned volcano, it is a beautiful mountain."

Biological rhythms and clocks have been the research interest of **John D. Palmer** for most of his career. He has studied rhythmic phenomena in many types of organisms, with his latest investigations centering upon the seasonality of flowering. Palmer, who earned a Ph.D. in comparative physiology from Northwestern University, is chairman of the Department of Biology at New York University. He has conducted field work in England, Bermuda, Bimini, and at the Marine Biological Laboratory at Woods Hole. His most recent articles for NATURAL HISTORY MAGAZINE were "The Many Clocks of Man," April, 1970, and "Geomagnetism and Animal Orientation," November, 1966.

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Letters

Hope, Hassles, and Horsewhipping

"Hassles in the Park" has little place in a magazine such as yours. We have been fed this propaganda for too long. We who love nature and all it offers believe that those who carry this sort of thing into Yosemite should be horsewhipped out of the park.

E. Emerson
Pinole, California

"Hassles in the Park," by Jack Hope (May, 1971), is a most sensitive and perceptive piece.

As municipal, county, state, and federal police seek to solve the larger problems of urban areas by increasing coercion and force, and rapidly change themselves into paramilitary organizations with helmets, machine guns, and armored cars, it is not surprising that American park rangers and foresters succumb to the same hysteria and seek solutions by adopting a "club, gas, and gun" philosophy of social control.

I do appreciate the ironical approach of the author and his expressed hope for communication between the Park Service and the long-haired generation, but I am dubious about the outcome. Unfortunately, today, as long as Park Service administrators and supervisors turn to the American police service for answers, they will receive the myopic "crush 'em, bust 'em" counsel and assistance—and that will only serve to extend the oppressive, repressive, "police state" air of the cities to include our parks, forests, and waters. The worst is yet to come.

A. C. Germann
Professor of Criminology
California State College

It is natural for infants to probe the restraints that encompass them as they learn the limits of their freedom in the real world. It has become a tragedy that permissive parents and aberrant educators have produced a class of infants whose physical age may reach thirty years, and whose tantrums sometimes include the violent disruption of such things as universities, judicial processes, and national parks.

It is not unusual for an older, sycophantic hanger-on to attach himself to a group of young people, adopt their speech and customs, and become convinced that they have discovered wisdom pure and unsullied. It is unusual indeed for the views of such a one to be soberly reported in the pages of a scientific journal.

It is true that Jack Hope has recorded the dominant theme of the "longhairs'" whimpering with his casual phrase, "social pressures and inequalities created by the over-40 generation." But why should this senseless tripe be given currency in Natural History Magazine? It is not the over-40 generation that dissident youth are rebelling against; they are fighting the ageless realities of life itself.

I have the uneasy feeling lately that scientific information about even the stars and planets may be subject to manipulation by the editors of Natural History to make it more "relevant."

Dennis Bryant
Macon, Georgia

I just finished reading, with great interest, Jack Hope's article, "Hassles in the Park." A few days earlier I had returned from another weekend of intermittent ranger hassle in Yosemite National Park. The energy the rangers devoted to these activities was incredibly wasteful to me. Last weekend a ranger told the group of climbers I was with that he intended to "find a way to cite every longhair in the park before he was through." Prejudice is part of the American way, I guess, but I strenuously object to being a subject of it when I am visiting one of my national parks. Of course, anyone who breaks a law or a park rule should be cited—the law is the law. And I know the Park Service has its problems these days. But to single out such a vaguely defined group for this general sort of harassment is a very ugly and ominous policy.

Last year I was leaving Yosem
with a carload of six people. We h
been backpacking in the high coun
for a few days and naturally
weren't exactly a well-scrubbed gro
We were tired and dirty. There w
a couple of beards. A ranger follo
us closely for several miles, t
turned on his flashers. When
pulled us over, he searched the
then told us we'd be in trouble.
manner was exceptionally rude.
left the park with some of our ha
feelings obtained in the wilder
changed to frustration and anger.
the same time, we were astonished
the incident. All of us were a
thirty years old and professi
people. In the car was an architec
magazine editor, an advertising e
utive, and a doctor. We were in a
capitalistic American car. All o
had been working for years, and
ing taxes that support the Nati
Park System. It must have been
beards.

Mr. Hope seems correct in ass
ing that the policy of the Park
vice is to harass anyone who is
obviously affluent, who is not i
chrome-decorated mobile home,
is not sticking to his car on the
roads and in the crowded par
lots, in the hotels and restaurant
this the new wilderness experienc
object.

Lynn Fe
San Francisco, Cali

Of course the park is too cro
and overused. And of course a
many people really don't appre
the great parks and would be b
served by recreational areas.
when it comes to putting down
more traditional visitors" as co
in their mobile homes and bri
portable TV sets, playing cards
and vermouth, I must protest
course some of them do, just a
kids bring their tape recorders.
it has been my experience that
these TV sets are a pain in the
they aren't played as long and a
into the night as many of the
play their records. These people
other things as well—*The N*

story of the Sierra Nevada, fishing ar, *A Field Guide to the Western rds,* sketching and painting equipnt, and cameras. And for all their lts, I'm willing to bet that man for n they are as worthy as the kids. ough you wouldn't think so to read . Hope.

What gripes me about Jack Hope his damned self-righteousness. He l his generation don't have any nopoly on virtue.

ETHEL UNSELT
Berkeley, California

Wolves of Isle Royale

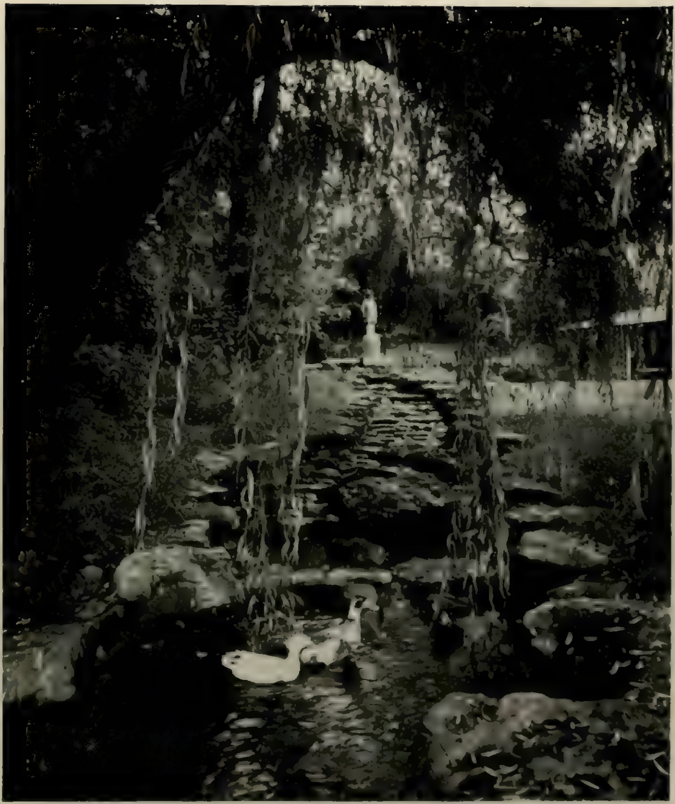
The recording "The language and sic of the Wolves" was simply fasating and I hope it will secure the est possible distribution. I knew I read something on the subject viously and my library turned up *Wolves of Isle Royale,* written by id Mech who assisted in the rdings. His 210-page, soft-cover k supplements the record beaully, and I am sure my fellow assoes would like to know that it is sale by the Government Printing e, Washington, D.C. 20402. One ar will return some of the finest ling obtainable on the subject. It dentified as "Fauna of the Naal Parks of the United States—na Series 7."

L. L. WALTON
Flushing, New York

Advice to Skin Traders

ongratulations on the Wayne g article in NATURAL HISTORY AZINE. I think it will help a great y people understand the complex ground of the Mason Act and l the wave of reaction against the cessary loss of natural species to e and vested interests.

ecies are dwindling fast enough re growing pollution and habitat uction. To stem these forces is g to take a lot of energy and . Meanwhile, one obvious thing to is to stop uncontrolled exation, and Wayne King has made clear. Personally, if I were in the



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skin trade, I would think of so
other line of work.

ARCHIE C
Graduate Research Profes
University of Flor

Gennaro's Funny Foot

On reading the usual fascinat
biographical author sketches in y
March issue, I was most intrigued
the photograph of Joseph F. Genn
Jr. I can only assume that the
gular appearance of his right h
appendage alludes to your statem
that he "has experienced some pecu
effects of poisonous snakebites
tissue and bone."

As a professor of anatomy, I
naturally anxious to obtain a su
of this toxin that renders soft tis
transparent and at the same
darkly stains the areas of tendon
sertion on the phalanges. The te
ing impact of such a living de
stration is truly staggering, but b
rather fashion conscious the ob
side effect of this toxin concerns n
the pant cuff is half an inch hi
on the treated appendage!

J. SHERMAN BLEA
Professor of Zo
Acadia Univ

I wish to compliment Professo
seph F. Gennaro, Jr., for his del
ful contribution to your March,
issue.

However, I am not referring t
scientific contribution, "The Cre
Revealed," but rather to the deli
prank he boldly perpetrates in
"Authors" section. He must *i*
have, as you state, "experienced
peculiar effects of poisonous s
bites on tissue and bone." I
dered with laughter when I c
scrutinized his sandal-clad righ
and foot (!) in the accompa
photograph.

A touch of humor in these
times is most welcome.

PETER SCHOSSBERGER
Los Angeles, Cal

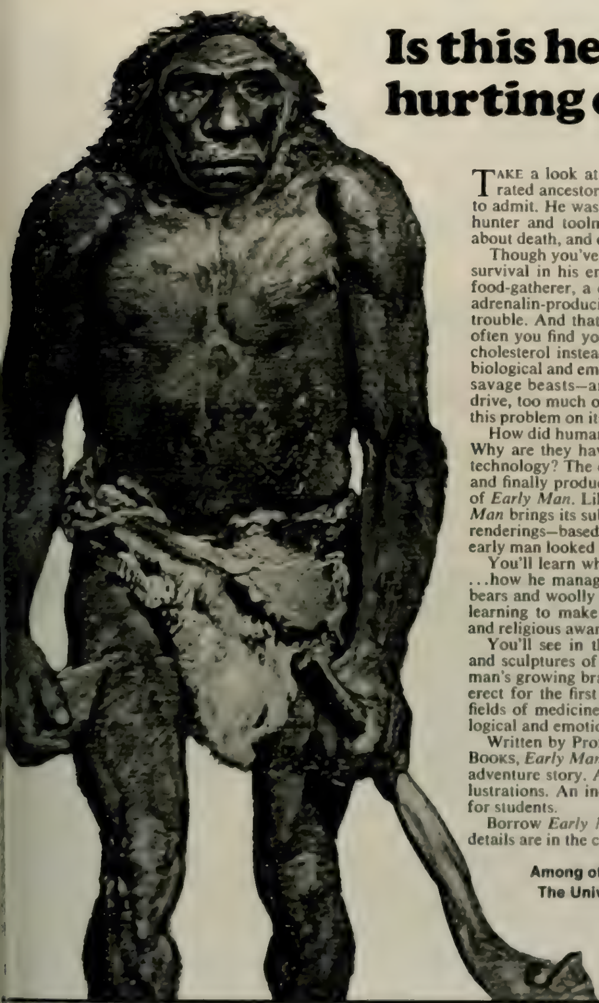
Inadvertent Zoo Keepers

A check on Kay Simmon's c
ing bestiary of New York City
ings in your May, 1971, issue r
that almost half the example
identifies are either on desi
landmarks or within historic dis

We have thought of oursel
preservers of architecture and h
It is nice now to realize that
also inadvertent zoo keepers.

HARMON H. GOL
Ch
Landmarks Preservation Com
City of Ne

How much of him lives on in you?



Is this heritage hurting or helping you?

TAKE a look at the Neanderthal Man and you'll see a vastly underrated ancestor of yours—more like you than you realize or may care to admit. He was the first true member of Homo Sapiens. An excellent hunter and toolmaker, he probably spoke a crude language, thought about death, and even felt the first stirrings of religion.

Though you've inherited his biological equipment, it was designed for survival in his environment, not yours. As a hunter of wild beasts, a food-gatherer, a creature forever in active danger, he evolved into an adrenalin-producing cholesterol-burner. He ran little risk of coronary trouble. And that's where his inherited traits may trouble you. All too often you find yourself angered into increased adrenalin flow, building cholesterol instead of burning it. You find yourself burdened with the biological and emotional equipment for hand-to-hand combat with great savage beasts—and while some of this helps to give you energy and drive, too much of it can kill you. That's why modern medicine has put this problem on its high priority list.

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Under the Power of the Gran Gadu

by Louis C. Whiton

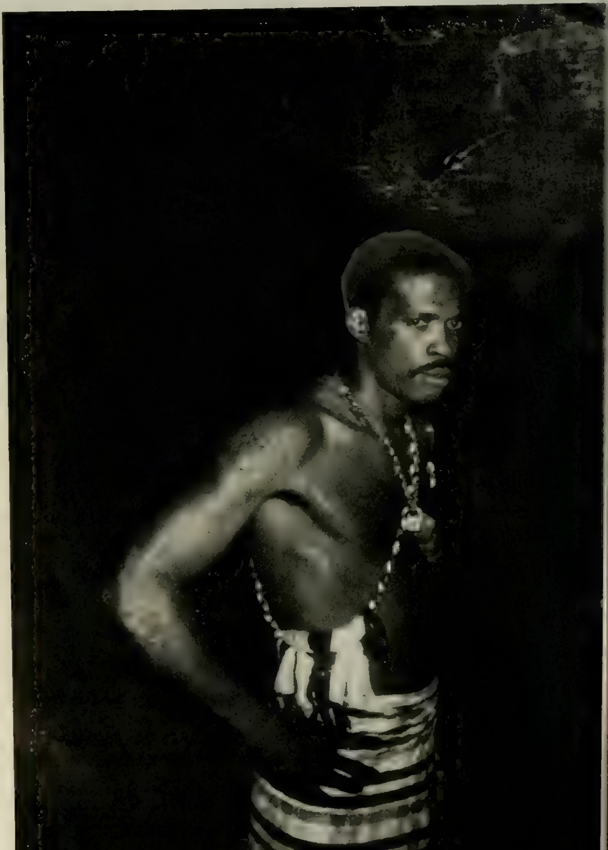
In a secluded hut amid the gloom of the Surinam rain forest, witch doctor Raine practiced an old form of psychotherapy

In some areas of the world supernatural practitioners known as witch doctors, shamans, or medicine men still treat the ailing. Generally relying on psychological means, rather than on jungle medicines, they occasionally appear to succeed when trained medical men fail.

I was cured by such a witch doctor under unusual circumstances. For two years I had suffered from lameness and severe pain in my right leg and hip, originally caused by acute trochanteric bursitis. Over a period of eighteen months, specialists and my own physician had used some of the latest methods of treatment, including three applications of local anesthesia, with no abatement of either the pain or the lameness.

During the previous twelve years, I had made a number of anthropological studies in Surinam, South America (formerly Dutch Guiana), among the jungle people known as Bush Negroes, descendants of six thousand slaves who had escaped from Dutch plantations in the early 1700's. Today some 27,000 of these people live in the remote rain forest. In their isolation they have retained to a marked degree the traditions, religions, and magic practices of their African ancestors.

I had become especially interested in observing the ceremonies, rituals, and evident cures by the tribal witch doctors. Since conventional medical methods had not eliminated my physical discomfort, the possible effectiveness of a jungle treatment intrigued me. I had planned my fifth expedition to



urinam, and by a stroke of good rtune, my personal physician was king his vacation at the same ne. Because of his interest in this usual type of psychotherapy, he cided to join the expedition.

Among the Bush Negroes, there so-called witches who practice ck magic, inflicting curses on th men and women, generally for sizable fee. Such malicious praces are considered mortal sins, for y are forbidden by their gods. In ntrast to a witch, a witch doctor's fessional function is to overne the effects of black magic, to ich are attributed most illnesses l deaths (a notion not uncomn in Western societies until a centuries ago).

To insure the maximum chance success, I sought out the most minent witch doctor in Pararibo, a man named Raineh. His ceful personality and his success h the Surinamese had previously ressed me, and many of the 's more educated people emyed his talents even though they nded Christian churches and consulted Western-trained phyans. Furthermore, he quali- for all three classifications of h doctor: as a *lukuman*, or thsayer; a *bonoman*, or medi- man capable of "pulling out witch" from sufferers afflicted a curse; and as a voodoo st, one of whose functions is to rcise the evil spirit. In Surinam neh is known as an *obiaman*.

nlike the conventional concept witch doctor, Raineh is normal appearance. Thirty-three years he is handsome, tall—six feet three inches—and has an athletic build, a necessity because he undergoes considerable physical strain and effort during his treatments. When I previously attended his curing ceremonies, I noted that his facial expression and personality differed for each of the three types of *obiaman* that he became. At times I found his expression disturbing. His eyes appeared to be focused at some point through and beyond me.

Although he came from a tribe in the rain forest, as a child his mother had taken him to Paramaribo, the capital city of Surinam. She was a convert to Roman Catholicism, and Raineh had attended the parochial school where he obtained a better education than most boys. He spoke Dutch perfectly and was fairly fluent in English, as well as in the Surinam language known as *takki-takki*, a type of pidgin English-Dutch-African developed by the early slaves. He told me that at the age of twelve, he had learned in a vision that he was endowed with power and knowledge from supernatural sources, and that Gran Gadu, creator of the world, would enable him to cure and help people. He confided this to his church confessor, who advised him that as a Holy Christian Father, his own duty on earth was to accomplish the same good deeds, and that the Christian God and Gran Gadu were obviously one and the same deity.

According to Raineh, after several years of study under older members of the profession, he spent a year in Haiti learning the rituals of Haitian voodoo and the art of hypnosis. He said that his snake altar came from Haiti and consisted of snake bones wrapped in a bundle and attached to a six-foot plank, with a small bell hanging beneath it. According to the voodoo religion, it is the snake bones that are possessed by the god. Voodoo differs materially in the several countries where this form of worship is followed: in Dahomey, Africa, where it originated; in the Caribbean Islands; in Surinam; and even in certain quarters of New Orleans, among others.

Shortly before midnight, my physician, five European and American friends, and the editor of a Surinamese newspaper accompanied me to the rendezvous in the forest about forty miles from Paramaribo. Although I understood the native Surinam language, the editor was to act as an interpreter because he was an expert in the type of ceremony we were about to engage in.

We drove along a trail until we saw a cloth tied to a tree. This was the signal to leave the automobiles. Here we were met by a Bush Negro carrying a torch, who led us slushing through a swamp—the barrier between the comparative civilization of the rough jungle road and the isolated area where the rituals could be practiced in complete seclusion.

The following account of the ceremony is based on the report dictated on tape by my physician during the event and also on the detailed shorthand notes taken by another friend. My own recollection is remarkably clear, in view of the impressionistic events, but more subjective.

"The ceremony of questioning my soul about my past life began."

The ceremony began at midnight and lasted until 4:30 in the morning. It took place in a large thatched hut called the "hospital," open on the sides except for a partition at one end and lit by a flickering torch of kerosine-soaked hemp. In the center was the magic circle, four feet in diameter and bounded by twelve bottles of various liquors. Within the circle was a low wooden stool for me to sit on, with a burning candle in front of it.

A white chicken, its legs tied together, lay on the ground outside the circle. On either side of the hut were red flags of indigenous Indian gods, considered by the blacks to be exceptionally powerful because they were the gods of the land before the African slaves arrived in the seventeenth century. On one side a voodoo altar rested on a wooden box. The melodramatic effect of the setting was ideally suited to the psychological treatment of a patient.

I was led to the partition in the rear of the hut and told to strip. A loin cloth was draped around me, and a wide white cloth was tied around my forehead. My body was rubbed with *pemba dotee* (clay) that had been mixed with the leaves of the *sangea fu-fu* and various other herbs. When such clay has been blessed with the proper ritual, it is believed to have the power to ward off evil.

To protect me, this clay was also sprinkled on the ground ahead of me as I was led barefooted to the magic circle. Sitting on the low stool, I fixed my eyes on the candle flame in front of me. Raineh commenced to chant, and the words and melody were repeated by ten male and female assistants, who acted as a response chorus. The monotonous rhythms repeated over and over again for many minutes created a hypnotic effect, in all probability an important part of the ritual. To frighten away evil spirits, large, noisy maracas containing snake bones were constantly shaken close to my ears.

Following the chanting and impassioned prayers to the jungle gods, which somewhat resembled activities at a southern revivalist meeting, Raineh filled his mouth with whiskey and sprayed it through his lips seven times on the chicken, with a prayer for each day of the week. Then he poured beer into the cupped hands of all those present and told them to wash their faces with it, while he prayed for their welfare, good health, and happiness—especially with one of the opposite sex.

The ceremony of questioning my soul about my past life then began. I was given a soup plate containing a heavy mound of *pemba dotee* surrounded by liquor to the bri which I held in my outstretch hand, my elbow resting on n knee. This is the traditional meth used by the Bush Negroes wh questioning an incorporeal enti such as a soul. The questions can answered by a "yes" or "no." T weight of the plate eventua causes the extended hand to beco unsteady, with the result that t liquid drips over the brim of t plate in one direction or anoth According to an accepted code, t location on the plate where t liquid spills indicates either an firmative or negative answer.

The interrogation was in *dee takki*, a dialect containing many rican words, originally develo by the early slaves so that th masters could not understand th Raineh's assistants appeared pressed, even shocked, by my closures. It therefore did not s prise me that after the question Raineh prayed to the god Misah "protect this Child of the Ea even though he has sinned, so t no harm will come to him."

During this part of the ceremo my doctor mentions twice on tape that he feared I would b the back of my hand because I holding the plate so near candle's flame. Having often served that natives in a state trance appear to be impervious high heat, I have since wonde whether I felt no sensation of cessive heat because I was in a si lar state to a minor degree.

At the conclusion of this par the ritual, the voodoo altar was raded around my head and flags of the Indian gods were wa over me. To attract the benefi local gods, Raineh told the audi to clap their hands, and the te and intensity were gradually creased until it was presumed the gods had arrived.

For two hours I had been sit on the low wooden stool and barely moved during the e time. As evidence of the hyperp ical effect of the ceremony, I perienced no physical discom despite my crouched position the lack of any padding.

The "pulling out the witch" ual now began, and Raineh's sonality changed from that soothsayer to that of a shaman

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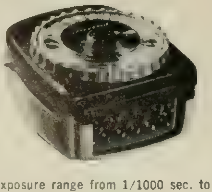

transfers the witch temporarily from the patient to himself. I was told to lie on the ground and the altar was placed beside me. Raineh lay down in the opposite direction, with the top of his head touching mine. The extremely heavy mortar in which the clay and the various herbs had been ground was placed on his chest, while one of his assistants stood on his stomach and another on his thighs. Two men vigorously pounded the mortar with large wooden pestles. I later learned that these precautions were meant to safeguard Raineh when the witch left me and entered his body. They believed that the rhythm of the pounding on his chest would keep his heart beating regularly during the ordeal and that the men standing on him would retard abnormal swelling caused by the witch.

After ten minutes Raineh started to groan as if in pain, and I was instructed to stand up. I felt this was to be the moment of truth. Either my long period of discomfort would be over, or the curing ceremony would have failed. Faith was important, and I made every effort to bolster my confidence in Raineh's powers. No doubt, at the moment I was also susceptible to plain old-fashioned superstition. Still, I was suddenly fearful that Raineh would fail.

I arose from the ground, and it was with controlled emotion that I then realized that all sensation of pain or cramp had disappeared. In the ensuing excitement my doctor grasped my hand and to my surprise said, "I was quite sure that it would work!" It was only later that I understood why he had said this.

Three of Raineh's assistants then attempted to lift him off the ground. He appeared to be in a tonic trance, his body rigid. Finally Raineh's assistants forced him to bend slightly at the waist. They supported him as he sat on the ground.

A remarkable transformation then occurred in his facial expression and his personality. I recognized from my previous experiences at such ceremonies that Raineh was now supposedly totally possessed by the witch and was no longer his usual self or in one of his priest roles. Raineh now became irascible and quarrelsome, and to
everyone's surprise, he began
speak in English instead of his n
tive *takki-takki*. Angrily he said,
don't like these people" (the Bu
Negroes) and, referring to me,
don't like Lou," and other u
friendly statements.

Speaking in English, the loc
newspaper editor demanded th
the "witch" tell where he ca
from and who his "boss" was. Th
referred to the person who, throu
the witch presumably had inflict
me with the curse. Raineh foug
against answering. Finally, thre
ened with never being allowed
return to his own country unless
answered the questions, he slow
and reluctantly replied. He s
that he came from a nation in
rica, which he named, and that
boss was from the same count
This startled me. I recalled an
fortunate and disagreeable alter
tion I had had three years bef
with a young African dignit
from that very nation, whom I
met at an important tribal ce
mony in the distant rain forest
Surinam. Since he was a member
a different tribe, Raineh coul
have had any knowledge of
event, which had occurred alm
two hundred miles away. It
known that the African area
ferred to is famous for its male
lent *ju-ju* men, who inflict bl
magic if hired to do so. Also,
glish is spoken fluently in this
mer colony, and when Raineh
become possessed by the witch h
once spoke in that language rat
than in *takki-takki*.

It seemed to be an unusual
amazing coincidence. I am cert
however, that many well-educa
people in Paramaribo would h
believed, beyond a doubt, that
was the origin of my trouble.

The next step in the curing ri
was to transfer the spirit of
witch from Raineh to the alta
snake bones. I sat on the low s
and Raineh sat on the ground
hind me, his shoulders pre
against my lower back. Afte
short time he began to utter
seemed to be undulating moan
pain, while the chorus continue
chant and shake the noisy mar
Raineh proceeded to tre
violently, and when this ceased,
face gradually assumed an
pression of gentleness and c

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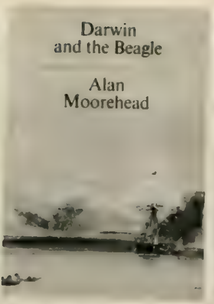

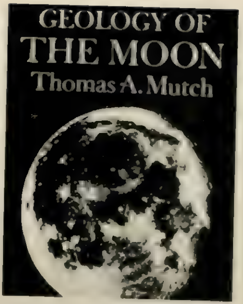

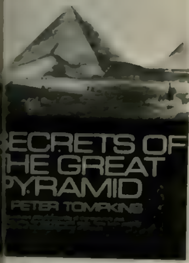

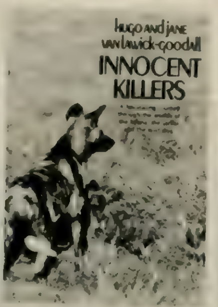

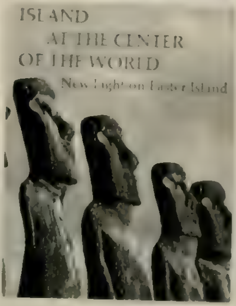

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This indicated that he now was assuming the role of a beneficent voodoo priest who inspires peace and order. The doctor and I assumed that it was at this time that the temporary transfer to the altar occurred.

As a voodoo priest, Raineh always walked on his knees, and he proceeded in this manner around the circle of spectators to give them his blessing, wishing them good health and fortune. They looked on the altar in awe as it was paraded around Raineh several times, while the bell tinkled and the chanting continued.

The next step was transferring the witch's spirit from the altar to the body of the chicken. Taking the bird gently in his arms, Raineh began whispering to it earnestly in *takki-takki*. He appeared to be consoling it for its eventual fate. One end of the plank holding the altar was then placed on the top of my head, and the other end on the head of one of the Dutch spectators. I was instructed to move in the direction indicated by nudges from the plank, which according to their beliefs were imparted by the god Dagowi who possessed the bones on the snake altar.

Directed by these nudges (imbalance of the heavy burden is a probable factor), I followed a zigzag course between the jungle tre and arrived at a small clearin Two large bowls containing liqui mainly water, were brought to t area. With joyous singing by t chorus and thanks and praise to t gods for overpowering the e spirit, Raineh grasped the chick by its legs, dipped it in the liqu and splashed it repeatedly over r body while the chicken vigorou flapped its wings and made rauco sounds.

Raineh then lifted the bird by neck feathers and held it in front me. He explained that unless it di without his injuring it in any ma ner, the witch would not be co pletely exorcised and might retu to me. If my pain recurred t could be used as a reasonable e cuse. Since the chicken did not a pear to be succumbing, Raineh sa that all of the evil might not ha been "pulled out of me." Co sequently he told me to open t chicken's beak and to spit into it, this might remove the last traces the witch in me and pass it to t bird. I did as he directed. For minute or two the bird flapped wings violently. Then, with a fi squawk, and to my astonishment, went limp and died.

Raineh assured me that chicken had died because of the e that had been transferred to it, a that my disability would never turn. I had not observed Rain doing anything of sufficient v lence to the bird to kill it, unl

"Raineh lay down in the opposite direction, with the top of his head touching mine."

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unconsciously, or even intentionally, his grip on the feathers near its throat had been sufficiently strong to strangle it.

The ceremony continued with singing, incantations, shaking of the maracas, and prayers of thanks. Herbs and *pemba dotee* were plastered on my wet body to prevent evil from re-entering it, and finally Raineh anointed me with a spray of liquor from his lips. The chicken was placed on the ground and I was instructed to stand on its body. Its neck and legs were severed by rapid blows of a machete, within a fraction of an inch of my bare feet.

The night had been long and eventful, and it was undeniable that my trouble had completely ceased. The important question was whether this sudden relief would last indefinitely. Now, more than two years have gone by, and I can say that I have never suffered even a momentary twinge of pain in my hip or leg. The scientific explanation given to me by members of the medical profession is as interesting and almost as fantastic to a layman as the ceremony itself.

The bursa, or cushion covering the upper end of the thigh bone, or trochanter, had become inflamed, possibly due to calcium deposits, a condition known as bursitis. After even moderate exercise, the leg muscles attached to my hip would go into spasm, followed by severe pain. Thus, the merry-go-round of spasm-pain-spasm continued even though the bursitis may have subsided after treatment. I was told that if this continues for a long period the symptoms may become even worse, since "a cyclic pattern transmitted through the spinal cord to the brain, of self-perpetuating impulses has been created, which results in chronic discomfort." Several injections of an anesthetic into the area were supposed to interrupt the pattern. Such treatment is classic and frequently results in lasting relief, although in my case it was only temporary. Medical men I have spoken to credit the complicated and mesmeric effect of the voodoo ceremony with psychologically breaking this pattern, since the brain is an important link in the cycle.

The doctors considered many factors significant. Raineh's charismatic personality was one. He was
a showman and amateur psychia
trist of no mean ability. He ha
complete confidence in his powers
so much so that he suggested that
pay only half his fee and forwar
the balance when I was certain tha
the effects of the black magic woul
not return.

Undoubtedly the ritual, with it
monotonous rhythmic chanting, th
intense and continuous din of th
maracas close to my ears, and th
ecstatic appeal to the gods, was i
tended to produce a mesmeric i
fluence. In addition, the eerie a
mosphere of the jungle hut lit b
the flaming torch, the candle o
which I fixed my eyes, the tinklin
bell attached to the altar, and ev
the impact of sacrificing t
chicken contributed to the effect.
have since asked myself, "Was
hypnotized to any extent during t
ritual?" If I was, I did not reco
nize it at the time.

Christian religious cures f
quently succeed when strictly s
entific approaches have failed
cause they are deeply rooted
spiritual faith, which provides
powerful emotional factor. In t
instance of this voodoo ceremoni
this factor also played an importa
part.

I asked Raineh how he perso
ally avoided subsequent attacks
witches for having foiled their e
practices. He assured me that
possessed a powerful *obia*, or feti
that protected him. Furthermo
Raineh professed to be able to
flict black magic on the witch.
presented me with an *obia*, an
ject of no material value, and sa
"If the witch ever tries to return
you and you again feel pain, h
this in your hand and you will
well again."

Science and the medical pro
sion have attempted to explain
success of treatments such as
neh's. But some doctors I h
talked to about this subject have
pressed regret that the great
vances in surgical practices and
use of drugs during the last th
years have obscured the importa
of the mind in curing bodily ill
professor at one medical school
me that much more attention is
being given to psychosomatic
tors in treating physical sympt
There is obviously much to l
about such phenomena.

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rch 3 to March 31, 1972

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win's Galapagos:
ch 30 to April 20, 1972

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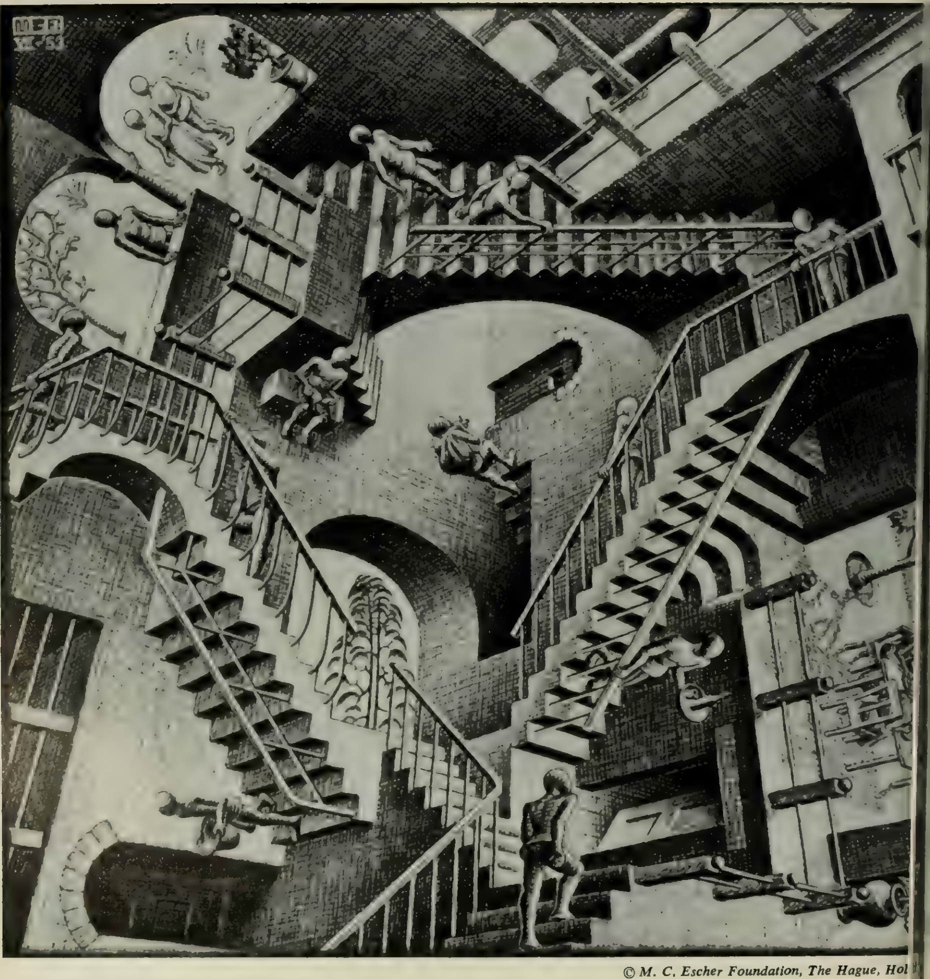

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VERY PURPOSE

Man must
earn to add
a fourth
limension,
ime,
o his conceptions
f the
nvironment"

y Robert Sommer

It is hard to imagine a world without time, but it is at least as difficult to conceive of time itself. For one thing, our vocabulary hinders us: our words are static and structured while time involves movement and fluidity. Time is built into every sentence and every percept.

A man sees a forest, a coastline, or a prairie in a time framework of the past, present, and future; progress and decay; projects and prospects. His experience is affected by *duration*—the amount of time he spends in the setting; *tempo*—a lake looks different when he is driving past at 70 miles an hour from when he is walking alongside it; *sequence*—certain paths provide contrasts and surprises while others prepare him for what is coming next; *chronicity*—several brief visits will produce an experience different from one based on a long visit; and *familiarity*—as a visitor, he and an old-time resident share space but their experiences will be different.

Time passes more rapidly as a person gets older. Le Comte du Nouy has calculated that a 20-year-old man experiences time passing four times faster than a 4-year-old child, while a 90-year-old man experiences it passing six times as fast. A child's earliest words concern the present. By two years of age, words indicating future time become part of his spoken vocabulary—phrases like "in a minute" or "I am going to." Concepts of the past usually appear about six months later. While time contracts with age, space expands. As a person ages, his home range increases and wider reaches are open to him.

Other cultures conceive of time in ways unfamiliar to most Westerners. The Indian psychiatrist Shashi K. Pande found that the Westerner views time as "a unique opportunity, to be utilized and be filled to the utmost with engagements, events, and endeavors in order to capture the richest share of life." He describes a Malay prince's first visit to London to attend the coronation of Edward VII in 1902. The prince remarked to his escort that he understood for the first time why Europeans valued time so highly: "In England each day is so packed with living that if a man misses so much as a quarter of an hour, never again will he catch up with the minutes that have escaped him. With us life saunters; here it gallops as if it were pursued by devils."

The sociologist Pitirim Sorokin maintains that each culture and academic discipline has its own conception of time. There is geologic time, with vast spans that are incomprehensible to most laymen, biological time based on rhythms and internal clocks, and historical time based on events and cycles, and these differ in important ways from physical-mathematical time. While mathematical time is continuous and flows evenly without physical dates or points of reference, socio-cultural time contains markers and

(Continued on page [illegible])

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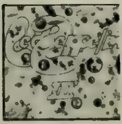

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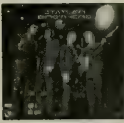

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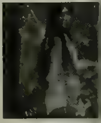

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65775 VERY BEST OF LOVIN' SPOONFUL
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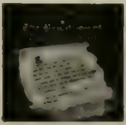

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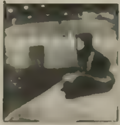

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Sensuous Symbionts of the Sea

In their struggle away from the mass of primitive life, and toward individuality, marine creatures have evolved barbs poisons, teeth, and a repertory of colors

by Lewis Thomas
photographs by Douglas Faulkner

One's first reaction to a close view of the life of the sea is confusion, unease. How can things be so beautiful, with such intricate balance and symmetry in their infinitely varied forms and, at the same time, seem so hostile, so threatening, ready to lunge, to snatch life from each other? So many of the moving parts of sea life seem to be designed, exquisitely tooled, for nothing but destruction and devouring. It is disconcerting, almost as though we have had the wrong idea about beauty and harmony; living things so evidently aimed at each others' throats should not have, as these things do, the aspect of pure, crystalline enchantment.

Perhaps something is wrong in the way we look at them. From our distance we see them as separate, independent creatures interminably wrangling, as a writhing arrangement of solitary adversaries bent on killing each other. Success in such a system would have to mean more than mere survival; to make sense, the fittest would surely have to end up standing triumphantly alone. This, in the conventional view, would be the way of the world, the ultimate observance of nature's law. It was to delineate such a state of affairs that the hideous nineteenth-century phrase, "Nature red in tooth and claw," was hammered out.

What is wrong with this view is that it never seems to turn out that way. There is in the sea a symmetry, a balance, and something like the sense of permanence encountered in a well-tended garden.

To be sure, individuals die—in such abundance that a permanent shower of organic fragments descends through the layers of the ocean—but the whole system survives and thrives and remains in balanc The creatures flourish, in vast surfeits. They feed each other; it does not distort the arrangement say that they are feeding each other.

On another level, they can be seen to be co nected to each other. Once this view is opened, t extent of their interdependence and connectedness astonishing. Nothing lives alone. One cannot find genuinely solitary form, uncoupled from everythi else. Instead, life is a dense, shimmering matrix live tissue, in which the creatures of the sea spring view as working parts, like cells in tissue or orga in an organism.

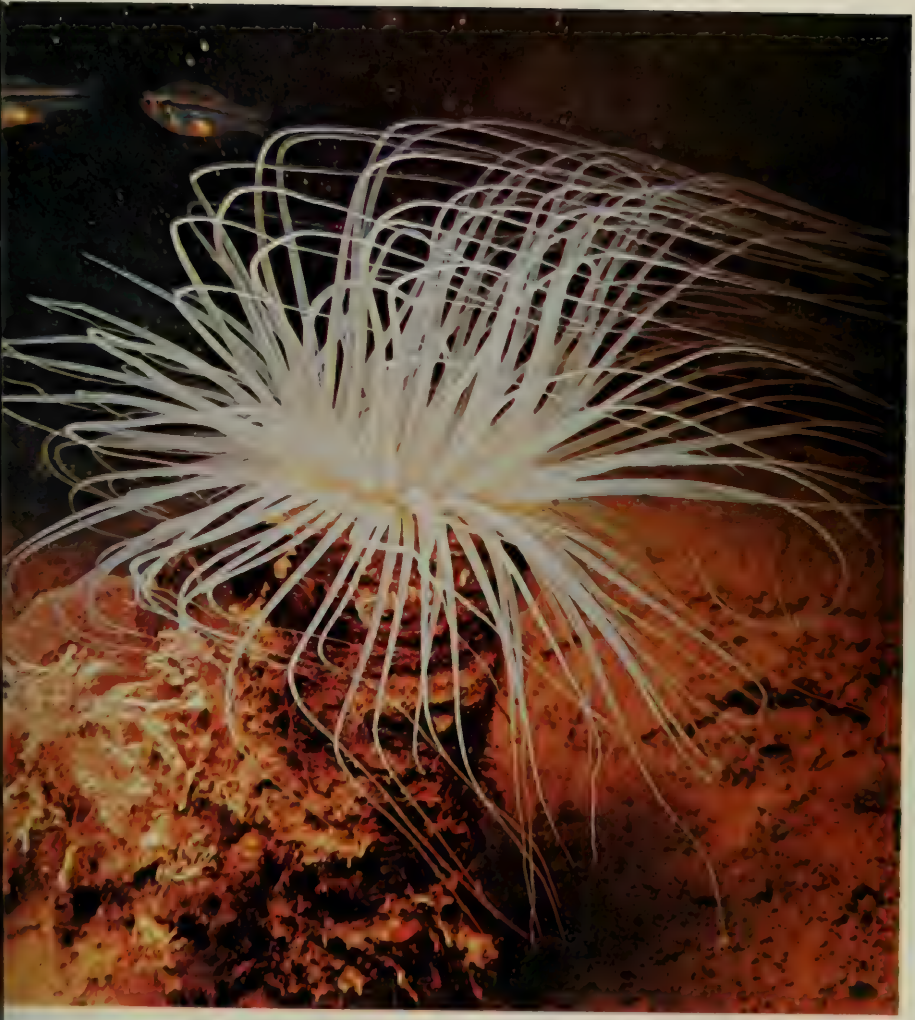
For all their appearance of readiness for comb the animals tend to move out of the way of a batt especially when the circumstances stipulate t someone has to lose. The coelenterate species Gorgonacea illustrates how an individual organi may simply bow out when necessary. Gorgoni tend to grow in closely arranged masses, but they not fuse. Jacques Theodor has shown that when t are placed side by side, pressed against each oth the smaller will always undergo disintegration. It the smaller partner that turns on and governs lytic enzymes. The smaller gorgonian is not done by the antagonist, but simply retires, totally.

Many of the negotiations between marine anta onists are conducted discreetly, by chemical me ators, with the adversaries keeping at a suitable d tance, beyond grasp much of the time. Star release a substance that will set any nearby scal in violent, fleeing motion, clacking like agitated d tures. Fish communicate by a diplomacy of cl

A bullrout's colors blend with the sea bottom at Tanabe Bay, Jap but its needle-sharp spines help keep it apart from other life in the s

In Turtle Bay, Kenya, a lionfish's ornate display warns off predators. A mechanism similar to a hypodermic syringe can eject venom through tubes in the fish's spines.

A crown-of-thorns starfish attacks coral at Amédée Island, New Caledonia. Because reef life is interconnected, the recent starfish invasion has killed many species in the Pacific.



At New Caledonia, the stinging tentacles of a sea anemone harbor small fish and shrimp.
The small creatures lure larger prey into the fatal trap of the tentacles.
Then all the symbionts dine.

ical signals. Bullheads, for instance, release substances that enable other members of the species not only to identify each one as an individual but also to discern the order of rank; a retiring bullhead, recently defeated in a contest for leadership, will have a different smell from the one that has just become chairman.

The threatening gestures, the wild declarations of hostility, often turn out to be signals, warnings, pronouncements of individuality and territory. The creatures of the sea are marvelous in their ornamentation, their embellishments of selfness. They flag each other off, send chemical information to each other announcing the inviolability of their various households.

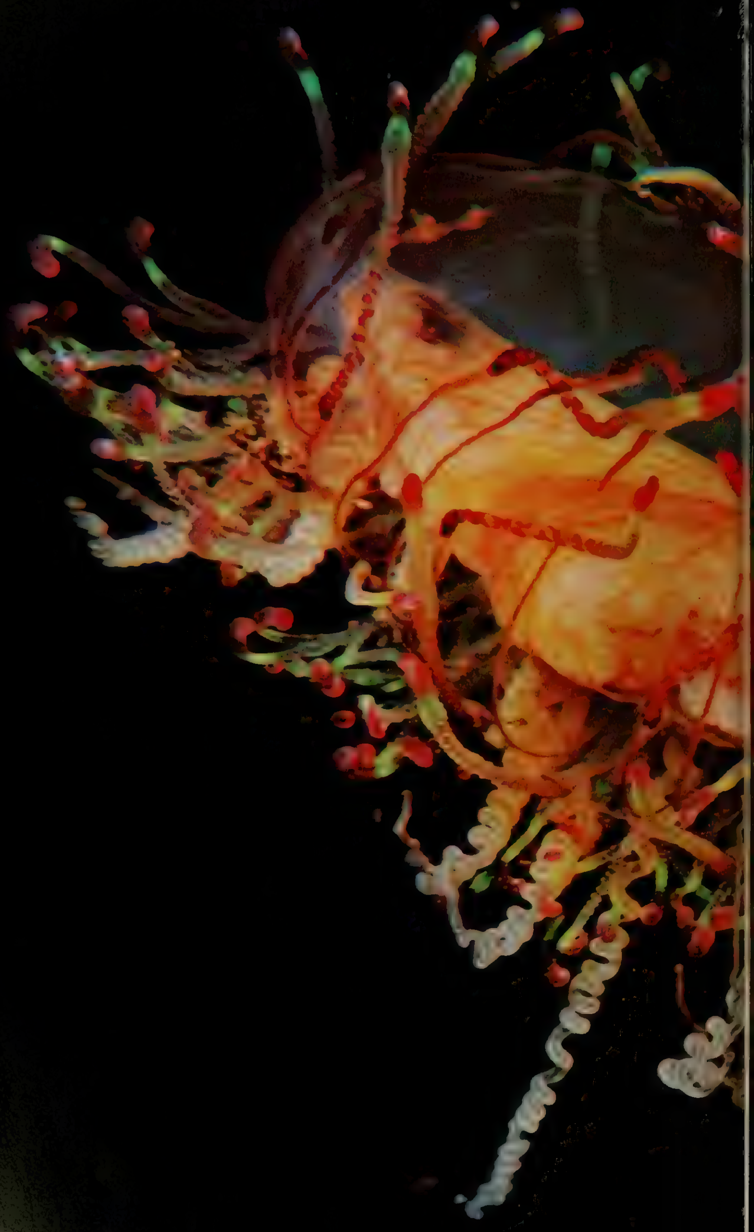
Thus far, this is familiar territory. This is much the way our body systems work; we have immunologic mechanisms that detect foreign creatures, and we prevent bacteria, fungi, and viruses from overrunning our tissues by mobilizing our reactions inflammation and immune defense. Our mechanis are efficiently designed to engulf and eject anythi that does not belong. To be sure, it is precisely th kind of defense that often gets us into the difficulti we recognize as disease, with inappropriately viole inflammatory reactions or sometimes, due to mi information, with the kinds of destructive tissue l sions called autoimmune disease. Nevertheless, w place solid reliance on immunologic recognition our protection against everything outside ourselv

But the recognition systems used by creatures the sea appear to have an altogether different fu tion, at least some of the time. There are multitud of animals with the most exquisite and precise mec anisms for identifying the surfaces of cells and t sues other than their own, and these are used not f defense or aggression, but to get together. They a not immunologic in our sense; indeed, they do n

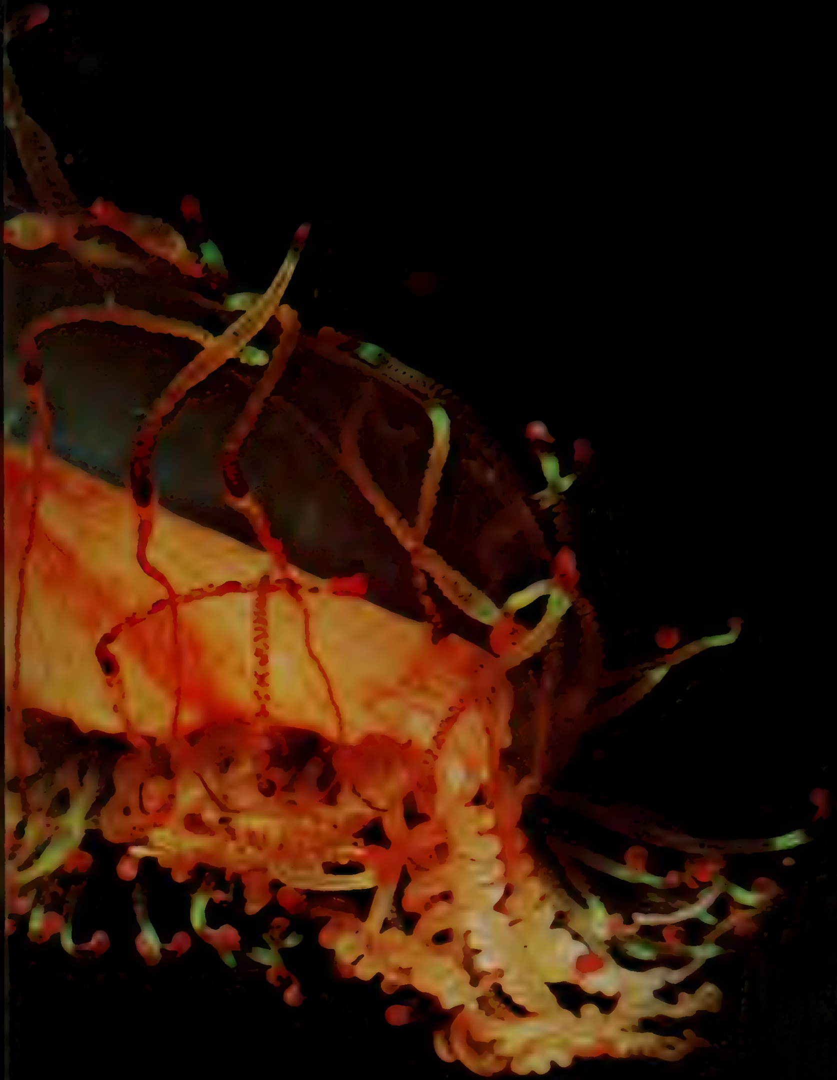
A brown moray eel pokes its head out of the North Channel Reef of Abeyabu Island in the Palau Islands. Like many marine creatures, the moray eel is only dangerous to humans when disturbed.

ool of stinging catfish
ns over a reef at Amédée
d, New Caledonia. Their
ling behavior, as well
ir stingers, helps protect
from predators.

ar Eilat, in the Gulf
Aqaba, a blue-spotted
gray skims along the
an bottom. Swimmers who
dvertently step on them
y suffer painful wounds
en the rays flip their
bed tails forward.



A Formosa jellyfish drifts in silent, colorful splendor in the dark waters 50 feet below the surface of Tanabe Bay, Japan. The delicate tentacles are lined with nematocysts, minute organs capable of producing violent stinging reactions.



volve the formation of antibodies and antigens. In eir net effect, they enable one creature to locate e special animals of other species with which it rms advantageous partnerships. Somehow, the enomenon of symbiosis has evolved in the life of e sea with the same degree of specificity and ac-racy that has characterized the emergence of im-unologic mechanisms in other forms of life.

Take, for instance, the hermit crab, which lives in mbiosis with an anemone perched like an orna-ent on its shell. The crab will seek out and can find partner in a crowd. The anemone, for its part, can entify its particular kind of crab by chemical arkers on the shell surface—a molecular recogni-n of a high order of sophistication. The anemone ay attach itself, or the crab may pick the anemone in its claws and fix it in place. Certain crabs will rry their anemones around permanently attached their claws, using them as a sort of dining imple-nt. The food is caught by one partner, sampled, d passed along to the other.

There are barnacles that live only on the surfaces certain whales, and there are other barnacles that en attach, selectively and with the same specific-, to the backs of those barnacles. There are fish t live out their lives amid the lethal tentacles of rtuguese men-of-war, shielded by the nematocysts d fed whatever comes their way. Other fish, like damselfish, are always found in association with cific anemones; early in life they must learn their y into the tentacles by swimming tentatively und the borders, until they become somehow la-ed so that the anemone no longer recognizes m as nonself.

The life of the sea is filled with the most fantastic angements for partnerships, condominiums, com-nities. There are the narrow, elongated arrowfish, igned to live poised forever between the sharp nes of sea urchins; the serpentine fish that live, reasons of their own, inside sea cucumbers, into ich they swim gracefully, tail first, through the aca. Some fish are adapted to life in the imme-te vicinity of larger fish of a different species; ne have developed suction disks so they can be ried by their particular host. Fish of all kinds are e to recognize the extraordinary species of ner-fish; they will queue up to have their sur-es, and even the insides of their mouths, picked nd cleaned.

Sometimes there are inventive adaptations that m to be in the process of being worked out, like liminary sketches for future evolution. Several years ago some Australian surf bathers were stung by what felt like jellyfish but turned out to be *Glaucus*, small nudibranchs, which had fed earlier on Portuguese men-of-war. These mollusks had edited their meal, permitting the stinging cells to migrate intact through their bodies to their surfaces, and preserving for the time the essence of jellyfish in a kind of limited partnership.

Sea creatures tend to live together, not because they lack the mechanisms for self-discrimination or the ability to discern the differences of others, but rather because their associations are so highly selective, and their discriminatory properties are so extraordinarily sensitive and accurate. The distinctions we make between organisms have a different meaning, almost the opposite kind of meaning, for these creatures. Some of them even overlook the doctrinal separation of animals from plants that we take so seriously in our taxonomy, and they put members of the two kingdoms together in the same tissues, sometimes in the same cells. The giant clam, for example, contains in his siphonal tissues a green pasture of algae. The clam, dependent on the photosynthetic contributions of the plant cells, lives with the green tissue always facing up toward the sun; there are small lenslike structures, adapted from visual organs, arranged over the algae to focus sunlight on them. It is an amiable, bucolic accommodation, but it comes as a shock to us to learn that algae are sheltered and encouraged to multiply inside the clam's phagocytic cells. We have become used to the idea that these cells are our primary lines of defense, the most fundamental of the aggressive mechanisms in the human system.

A coral reef is a universe of symbiotic relationships. It is like a giant organism, with various working parts made up of polyp, fish, worm, plant, crab, mollusk, plankton, all interdependent. When disease occurs, as in the ulceration of a reef by the crown-of-thorns starfish, you can count the many different life forms bound together in one reef by the number and the variety of casualties.

The tendency to live together in close partnerships may represent the most ancient habit of all living things. Perhaps it is most conspicuous in the sea because life began there and the habit has hung on in undisguised form. When you consider what the earliest stages were probably like, the pattern of symbiosis has a certain consistency. There was, according to current theory, a first cell type, probably a very first single cell, put together by a lucky aggregation of polymers formed from basic ingredients in

Continued on page 78

gment cells, called chromatophores, in its
n enable the cuttlefish to change colors and
nd with the background on Amédée Island Reef
New Caledonia. The cuttlefish uses its
tacles to pull prey into its powerful beak.

The Apes of Gibraltar

With a little help from their friends, Barbary apes thrive amid the garbage cans and gun emplacements of the great rock fortress

by Barbara R. and Michael H. MacRoberts

At the southern tip of Spain three-mile-long, three-quarter-m wide peninsula juts into the Me terranean Sea; like an immense verted limestone wedge, the Rock Gibraltar rises abruptly 1,400 f from the surrounding water. At northern end, across the low, sar isthmus, which is neutral grou the hills of Spain lie in som shadow. To the west is a large, sh tered bay, and on its opposite sh stands the once-Moorish city of geciras; to the south across straits is another continent, Afric

The place names of the city, names on walls and gates, the c of arms presented to Gibraltar Isabella of Castile when the R housed a Spanish garrison, all flect the vicissitudes of governm and custom of one of the m fought-over pieces of land in tory. Gibraltar has been besie many times, the last attack be the "Great Siege" more than ha century after the British ap priated the Rock from the Spa Crown in 1704. And the name braltar, *Jebel-al-Tarik,* the Moun Tarik, evokes the fortress' eig century beginnings when the pr ontory was taken by Tarik and mercenary army from Morocco.

Today, Gibraltar is still a g

ı. The town, with a population of out 28,000 people, runs the gth of the western shore and nbs in narrow, winding streets ond the ancient walls of the orish castle to the north. Miliy offices and quarters run along waterfront and mingle with the ıses that terrace upward in oked lines of stucco and red tile. as capped with bright, flowering tigens stand against the stairys. In the polyglot murmur of ly morning, black-garbed mans haggle with fruit and vegele vendors. Sailors on shore ve from many navies saunter wn Main Street, perusing the dy wares on display or stopping h the crowd to watch the miliy band in front of Governor's use.

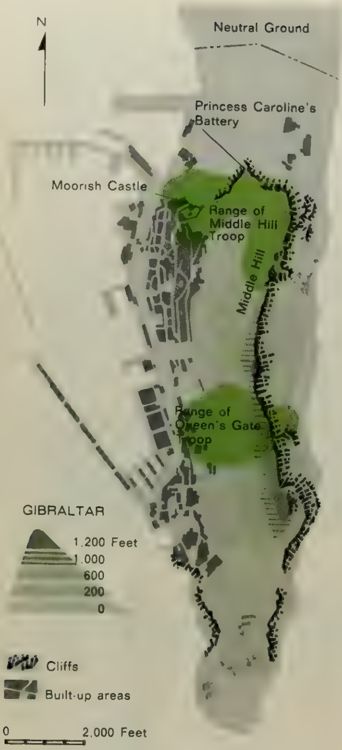
ut above the pepper trees and d olives of the town, well beyond ch of the staccato cries of fish dors and the declamations of rning shoppers, the only feral ulation of monkeys in Europe ms the military land that tches the length of the Upper k. Here, among rusting cannon d grass-choked trenches, monkeys e lived for centuries: like the ple of Gibraltar, they too have d a long, tumultuous history.

Several years ago we had the good fortune to spend six months in Gibraltar where we made the first field study of Barbary ape social behavior.

Two troops of monkeys live on Gibraltar. One roams the series of overhanging cliffs and ravines at the north end below the high peak at Middle Hill; the other wanders the rock face at Queen's Gate farther to the south where the saw-edged mountain crest dips slowly seaward. Each troop keeps firmly to its own area, and during our stay, even though the Rock is only two square miles in area, these two troops—of some sixteen animals each—never met. At Queen's Gate, the monkeys are fed by a keeper, and it is to Queen's Gate that tourists come by taxi or cable car to see the "Rock apes."

The monkeys at Middle Hill, however, are not frequently disturbed by visitors, and it was for this reason that we chose to study them. Although considered wild, the monkeys at Middle Hill are accustomed to people and quickly adapted to being followed about through most of each day.

Barbary apes are stocky animals, with a heavy coat of reddish-mottled hair in adulthood. By June, as the fresh, herb-scented spring days pass into the dryness of summer, the handsome coat begins to shed, and by midsummer the thick mantle about shoulders and back is considerably thinned. On Gibraltar, Barbary apes have a restricted breeding and birth season. In late October adult females come into estrus, and through the wet months of November and December they solicit adult males for copulation. The dominant male in the troop fathers the young, and in May the first babies are born. Infants have black coats at birth, pink, crinkled faces, and dark blue eyes. At about three to four months, they begin to turn a russet brown; by three to four years, individuals have acquired the heavy brows and chin whiskers of maturity. Adults weigh between 20 and 25 pounds, and males are generally somewhat larger than females. In some old females the dense red coat and lowering brows are especially well developed, their whiskered faces thickly freckled across nose and cheeks. In general appearance, these monkeys resemble their congeners, but unlike the majority, Barbary apes have no tail in adulthood, although infants have a tiny nub of skin which most individuals lose by one year. The



Two troops of monkeys share the Rock of Gibraltar. One stays north of Middle Hill, while the other lives near Queen's Gate.

lack of tail has led to the misnomer *ape* being applied to the species; hence, *Barbary ape*, the name by which they are commonly known.

The Barbary ape, whose range includes Gibraltar and the Atlas Mountains in Morocco and Algeria, is but one of some twelve species that make up the genus *Macaca*. All the other macaques are Asian in distribution, extending from East Afghanistan into the Indian subcontinent and Ceylon, through Tibet and China into Japan, and south into the Malay Archipelago. It is probable that before or during the Ice Age macaques ranged from Japan right across the Old World to the Atlantic coast. Climatic changes in the Pleistocene, which affected Europe and the African littoral, must have resulted in a division of the westernmost macaque populations from those in the East, leaving the monkeys in North Africa a much-reduced outcrop of what was once a more widespread species.

But how Barbary apes originally came to Gibraltar remains something of a mystery. Two hypotheses have been put forward to explain their presence in an otherwise monkeyless Europe.

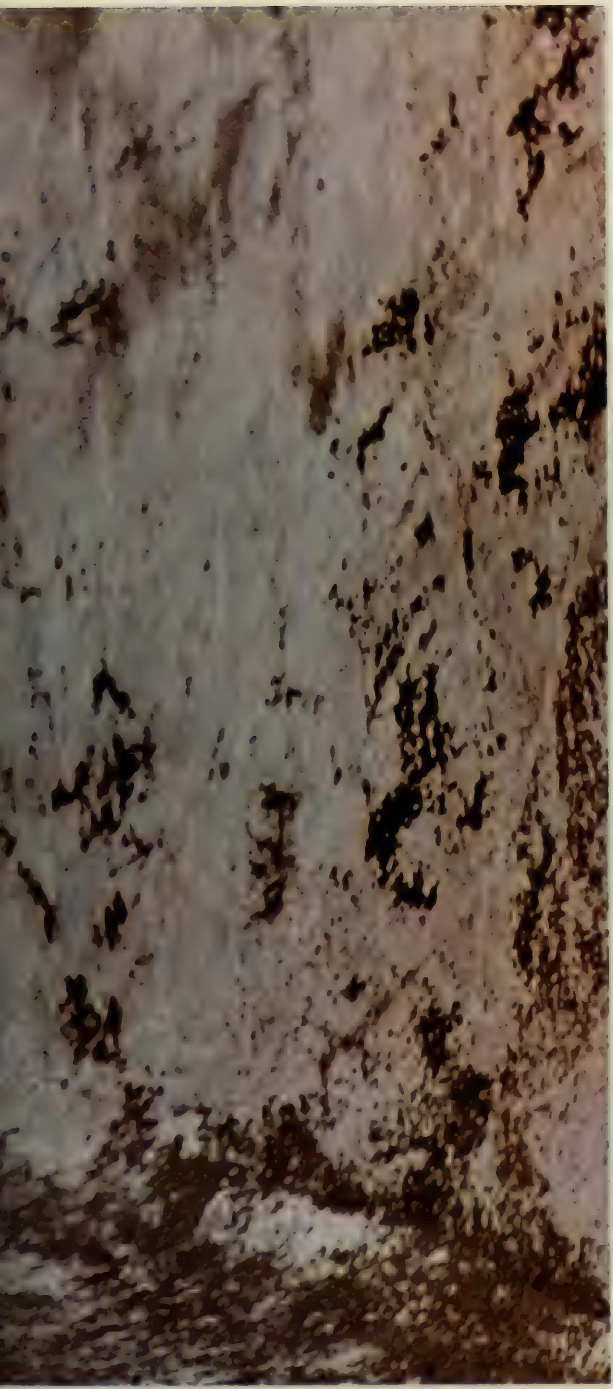
One is that they represent a remnant population. Fossil remains of macaques from the Pliocene and Pleistocene have been unearthed in several localities in Europe, but before or during the last major glaciation, monkeys vanished from Europe. On Gibraltar, although extensive excavations have been made in several waterworn caves, no macaques have been discovered in an otherwise rich fossil fauna.

The second hypothesis is equally difficult to support, but is perhaps the more promising of the two. At least as early as the Moorish occupation of southern Spain, monkeys were exported from North Africa to Gibraltar and elsewhere in Europe where they were sold as pets and to itinerant animal showmen. Monkeys were still being sold in the Moorish market on Gibraltar several years after the Rock became a British colony. It is suggested that some of these animals escaped from the markets or from their masters and took refuge on the Upper Rock, and that over time, continued additions in the form of escapees and births resulted in an established wild population here. Spanish histories of the seventeenth century speak briefly of monkeys living on the nearly vertical eastern face of the Rock. From here they occasionally moved to the western slopes, into the large gardens of the northern part of the town. The Upper Rock, although barren and inhospitable in its uncertain water supply and meager soil, would have provided a welcome haven for escaped "pets." With the more hospitable lower slopes permanently occupied man, the monkeys could suppleme natural forage, albeit at risk being killed or captured, with t plenteous litter of man's midde and the produce of his garden Here, too, would be a sure supp of water in cisterns built to cat the winter rains.

Today, the monkeys on the Ro include as part of their diet gard fruit and the generous leavings the garbage bins that proliferate the town's perimeters. And it is t expediency that has often led strained relations with Gibralta human inhabitants. Indeed, one the first records of the monke during British colonial rule is complaint that a large troop w damaging a garden and being general annoyance. Such lack of gard for human property result in deep-seated antagonism fr many members of the town, and prevent proscription of the ent monkey population, a garrison der was issued in 1856 forbiddi the killing of Rock apes. Within few years, however, they had to rescued again from the hands irate townsfolk. The governor Gibraltar reiterated earlier wa ings against harming the monk and went so far as to import a mals from North Africa to bols the dwindling population. Th individuals, two males and t females that were let loose on Upper Rock, were eventually cepted into the troop. Their numb grew, and sometime after 1863 troop split into two.

In the years that followed, c tinued forays into the city led t lengthening list of transgressi and by the end of the ninetee century the monkey population been considerably depleted trapping and shooting. Rene

Symbol of the Brit
presence on Gibralta
Barbary ape rela
in the Mediterranean



protection, however, allowed a recouping of numbers, to the extent that complaints again flowed in. The Admiralty finally requested that a watchman be employed to drive the offending animals up the Rock away from the town, and measures were taken shortly after to keep the monkeys permanently up the Rock by installing a keeper (a master gunner) whose duty it was to feed them at Queen's Gate. Money for this undertaking was provided by the Colonial Office, the amount varying from one pound sterling in 1913 to as much as six pounds per month in 1921 in what must have been a monkey-ridden year. An officer from the Royal Garrison Artillery was appointed Officer-in-Charge-of-Apes, and today this appointment is held by the commanding officer of the Gibraltar Regiment.

Despite these early efforts to curtail the monkeys' depredations, complaints continued, and by the 1920's public agitation reached record pitch. Although the Secretary of War expressed the hope that the monkeys would not be destroyed and the local press intervened on the animals' behalf, the two largest individuals, presumably the adult males, were shot. The governor subsequently conceded that householders could take any action they liked against monkeys that invaded their homes. In the years that followed, the monkeys declined rapidly in numbers, and at one time the population was reduced to three individuals.

Then in 1930, the plan still used today was devised: individuals were named and animals were imported from North Africa to reinforce dwindling numbers. Notices not to feed them were published. The

An adult female holds an infant so young that its coat is still black. By three or four months the coat will be brown.

onkeys persisted with minor fluc- ations in membership until the rly 1940's, when the entire popu- tion, except one aged, nonrepro- uctive female. died from unknown auses. Winston Churchill promptly rdered that monkeys be restored to e Rock, and a large number were nported from Barbary.

Today's animals are all descend- nts of the Barbary apes brought from North Africa nearly thirty ears ago. A keeper still feeds e animals at Queen's Gate and responsible for seeing to sick nd injured individuals. Two oops have been maintained on the ock with a total population of bout thirty animals. When num- ers exceed this, orders are issued y the Officer-in-Charge-of-Apes to ap some individuals and these are nt to zoological gardens around e world. It was not so long ago at two young Barbary apes from ibraltar were given to the San iego Zoo.

There is an old Spanish saying at when the monkeys leave the ock of Gibraltar so then will the ritish, and it is perhaps this single ctor that has preserved these most xatious mascots. Like the ravens the Tower of London, they have come a symbol in a tradition in hich such gestures are important.

All of the members of the troop Middle Hill were born in the oup and most will never leave the se vicinity of other group mem- rs. Occasionally, after a severe ht or a shift in dominance posi- ns, an adult male may temporar- quit the troop and wander alone veral hundred yards from it. The males and young, however, en- unter the same faces every day, d the only changes are the births in summer and the disappearance of individuals when death takes a member of the group.

But beyond the single segment of one life-span, the troop extends in a series of life histories, overlapping in time from the past into the future. The oldest female remembers individuals unknown to any other member of the group, and her infants will know individuals yet to be born, individuals she herself will never see. She watches her youngest infant whose world as yet scarcely extends beyond herself. He has little experience of the winding route down the Rock, which members of the troop have taken for years to their morning feeding area. Nor does he know that another troop of monkeys roams the Rock a short mile away at Queen's Gate. Perhaps he will never come in contact with them, for it is likely that even within his mother's generation few members of Middle Hill have ventured beyond the tiny range of the troop, bordered below by the city and above by the jagged crest of the rock. This tiny range to which they keep contains all their needs—water, food, and sleeping cliffs—and it will probably remain adequate for generations to come.

For Middle Hill troop, the day begins at dawn. The monkeys stir about on the ledges of the sheer cliff where they have spent the night, and as the sun rises, they ascend the cliffs to sit and groom in small units on the warming concrete of Princess Caroline's Battery. Infants suckle, adults groom, and juveniles play among the straggling conifers that surround the battery. Perhaps a few individuals will dig for roots or feed on pine nuts. As the sun rises higher, and the easterly wind condenses a characteristic cloud into a dark parasol over the Rock above them, the monkeys set off down the western slope toward the city. They cross the broad concrete pan of the water catchment above the Moorish castle, pause for a drink at a leaking pipe, then meander along the castle's crumbling walls to the town's edge where modern high-rise apartments fuse with its ruined ramparts. Here the monkeys begin their morning raids on the rubbish bins, sending the lids clattering onto the pavement in front of windows where housewives keep a wary eye on laundry hanging across the patios. In the course of the morning, a shirt or two may disappear, collected off the line by one of the adolescent troop members. But later in the day, these same housewives can be seen emptying whole loaves of near fresh bread into garbage cans.

Should the troop move farther into town, where figs, pomegranates, and other trees are in fruit, cries of "Mire, mire, los monos!" bring faces to windows; the poultry dealer on the corner momentarily loses his customers who step outside to watch the monkeys. Most mornings, however, the monkeys go unnoticed; they are part and parcel of every day. The pace is slow; food is abundant.

It was here at the city's edge, early on a spring morning, that we first encountered Middle Hill troop, at first impression a disorderly collection of animals feeding here and there among the refuse bins. But after several days of watching, we came to recognize and put a name to each face. As the months passed, our confusion slowly gave way to an understanding, however incomplete, of the relationships that existed between individual monkeys and, on the basis of this, to a picture of the more general patterns of their social organization.

In Middle Hill troop, a dominance hierarchy existed among individuals. Such hierarchies, a salient feature of many primate societies, are essentially a priority system between individuals, defined by each animal's ability to assert himself in interactions involving food, sleeping space, and—between males—access to females. Among the members of Middle Hill, such interactions ranged from mild threats, to which an animal reacted by moving away, to fights in which the subordinate individual was chased. Only rarely did these more vigorous fights result in injury.

The two adult males ranked highest, occupying the alpha and beta positions. The four adult females held the next four positions with

onkeys cavort on a wire
rrier designed to keep
em from throwing rocks
to the streets below.

juveniles and infants ranking below them. In young animals, rank was correlated with age, three-year-olds ranking above two-year-olds, and so on, irrespective of sex. Infants, however, had no dominance ranks among themselves.

This simple linear hierarchy was confounded, however, by associations in which specific adults interceded in antagonistic encounters involving certain other troop members. Most notable of such associations were those between adult females and young in which the female intervened for her own infant and for specific juveniles in their aggressive interactions with other members of the troop. In such cases protective behavior shown by the female mitigated basic dominance relations by giving the protected youngster what has been called a "dependent rank": the rank of the adult female when they are in close association.

Such associations involved more than protection of young individuals in aggressive encounters. If food was present in a nondispersed form, as in the refuse bins, these protected young had the prerogative of feeding with their adult protector, to the exclusion of all other individuals. Should any other troop member attempt to join them, the adult female would immediately threaten or chase the offender. The young animals could therefore feed before individuals who ranked above them. When one female–young unit had finished feeding and had moved away, the next ranking female and her dependents could appropriate the food source. If any juveniles or infants belonging to the preceding group remained nearby, they were summarily chased off. Adult males could feed with anyone, and other troop members could feed with them without fear of being threatened.

These same young animals were in frequent, close contact with their protectors and spent many hours each day in their company, resting and grooming.

Female–young associations similar to those described above have been found in Japanese and rhesus macaques, and in these two species, such associations comprise a mother and her offspring of several years. It is therefore probable that the female–young units in Middle Hill are just such mother–offspring units. If this is so, four such kin units existed in Middle Hill troop. The largest consisted of a mother and three dependent young, ranging from an infant to a subadult of three years; the smallest kin unit contained an old female and her infant, born during the summer.

It is into such units, then, that an individual is born. For the first several days of life the infant spends most of his time in his mother's lap. When she moves, he is carried against her belly to which, from the moment of birth, he can cling with amazing ability. Within a few weeks, however, he will move onto her back where he will be carried about, jockey style, for the next several months. During the early weeks of his life, he is the center of intense interest from older siblings and, to a lesser degree, from other members of the troop, especially adult females. Individuals advance toward the mother, giving the grinning gestures typical to initiating social contact. They sit in front of her, often with an arm around her back, and peer at the infant. At such times, the infant may be upended and held away from the mother, but is never taken from her.

During this early period in the infant's life he may become the center of interest of one of the adult males in the troop, and a relationship, mirroring that between mother and young, may develop. The male takes custody of the infant for increasing periods of the day, carrying him and holding him in his lap and, very shortly, assuming the role of a second protector. The mother appears in full accord with her infant's adoption and willingly allows him to be taken from her. During rest periods, however, the infant is usually back with his mother where he is groomed and suckled and where he sleeps, and at night he always descends the sleeping cliff in her care.

Both adult males in Middle Hill troop maintained such protector–protege relationships with specific infants. They virtually ignored the other infants in the group or behaved toward them in a manner o tolerant disinterest.

Such male-focal relationships like the mother–offspring tie, ex tend beyond the dependent animal' infancy; one of the males in Middl Hill protected two juveniles in similar manner. One of these, one-year-old female, belonged to kin unit and was protected by he mother as well. The other, an ado lescent male of two, had apparentl lost his mother and had no clos ties with any of the adult female He spent most of each day in th male's company. They played t gether, were grooming partner rested and slept in close proximit and when not in actual contact, th male was never far from his pr tege, whom he protected in a ma ner similar to that of a female ca ing for her very young offspring.

It is possible, although we ha no way of knowing at present, th the male–young relationships a also based on kinship; that th

ales choose as proteges the young their sisters or their own sib- gs. In the case of the alpha male, ch infants will probably be his n offspring since it is the domi- nt male who fathers most, if not , of the young.

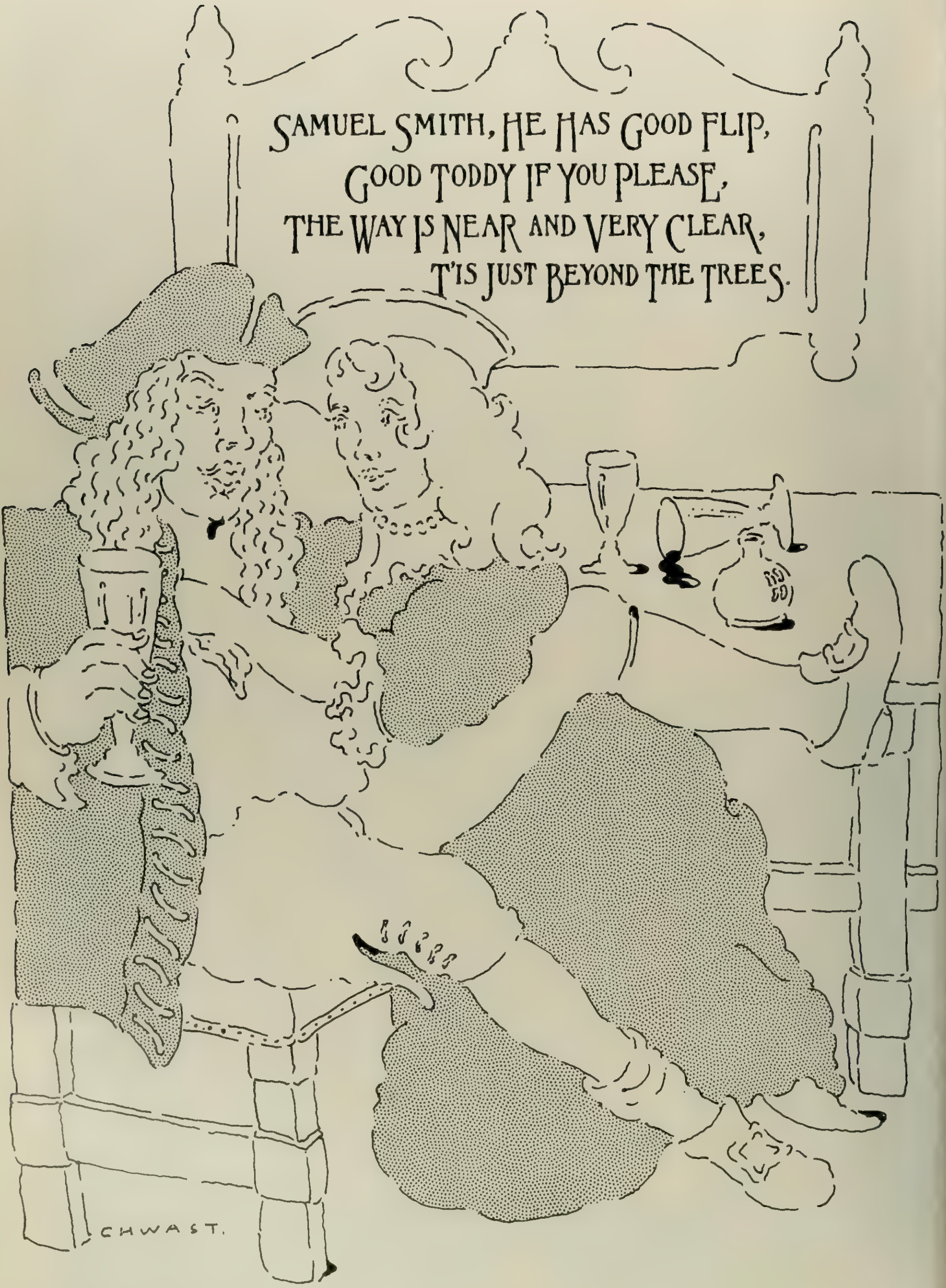
Not every young member of ddle Hill could claim such rela- nships, and where such ties did t exist, their importance became the more striking. Two one-year- ls in the troop had no close asso- tions with either an adult female an adult male; presumably their thers had died or had been re- ved from the troop. Unlike their re fortunate peers, they were quently the brunt of aggression. ey had little contact with animals ir own age since lack of a pro- tor affected even their status with rs, who could take advantage them in play-group scuffles. ese two youngsters remained pe- heral to the troop; they fed alone r all other individuals and ely were the center of grooming ractions. Except for each other's company, they were forced to lead an almost solitary existence.

The Middle Hill troop, then, can be viewed as consisting of a number of kin units, centering around each of the adult females, whose members spend more time with each other than each does with nonrelated individuals. Such ties are, for some young animals, extended to include close association with an adult male. These preferential relationships are a most important basis for social contact in the troop and through them an individual monkey's position with his fellows is mediated.

As the long, midday rest period comes to a close, groups of females and young move down from the walls and housetops where the troop has spent the afternoon sleeping and grooming. Several individuals stop to feed on the morning glories covering the sides of a rickety chicken coop behind the buildings; the same garbage cans that were raided in the morning are searched once more, and after a hasty feed, the troop moves back up the Rock to Princess Caroline's Battery. Mother and young walk together, and an infant sits astride the shoulders of an adult male. Adolescent play partners lope along side by side, and as the troop winds past the Moorish castle, the two motherless juveniles trail behind.

The trip back up the Rock is more rapid than the leisurely descent in the morning, and within thirty minutes the troop once more spreads out across Princess Caroline's Battery. One of the adult males wanders off, out of sight, an infant still riding his shoulders. Females sit and doze. Once again the juveniles play. As the sun begins to set, the monkeys descend to their sleeping cliff where they will remain until morning. From Alameda Gardens, in the southern part of the city, north past the cemetery where some of Trafalgar's dead are buried, dusk turns the town slowly gray, and the lights of the harbor begin to wink. The Mount of Tarik stands black against the sky.

ROCK APES
DO NOT FEED APES
THAT ARE ROAMING
WARNING
APES REACT VIOLENTLY TO SUDDEN
MOVEMENTS AND SOUNDS AND OFTEN
CARRY AWAY ARTICLES SUCH AS
HAND BAGS AND CAMERAS.


SAMUEL SMITH, HE HAS GOOD FLIP,
GOOD TODDY IF YOU PLEASE,
THE WAY IS NEAR AND VERY CLEAR,
T'IS JUST BEYOND THE TREES.
CHWAST.

WELLFLEET TAVERN

by Eric Ekholm and James Deetz

In the days when settlements vere springing up along New England's coast and whalers plied the ffshore waters, all good taverns oasted the excellence of their flip nd toddy. Flip, a frothy, spiced-ale rink. and hot rum toddy were the pecialties of these haunts.

In 1969, when archeologists from limoth Plantation and the Naional Park Service visited Cape od's Great Island in Wellfleet Haror, there was little surface evience to indicate what might be ound there. Local traditions were ague, but one suggested that in the arly seventeenth century the island ad been the site of a Dutch tradg post. Another told of a tavern at had existed there, complete ith a sign advertising the hospility of one Samuel Smith.

Some previous unauthorized diging at the site had turned up a 723 English coin, as well as some oons and clay pipe stems. Here nd there, rocks projecting above e surface of the ground were posble signs of a buried foundation. uring the summer of 1970, the arheological team turned up many lues, including bits of ivory fans, ieces of whalebone, smashed rinking containers, clay pipes, and eramics. The interpretation of eir meaning led to research on a umber of aspects of early Cape od history. A neat fit between arheological and historical evidence merged, and the local tradition deribing a tavern on the site seemed ell corroborated.

Today, Great Island is part of a ng peninsula that forms the westrn side of Wellfleet Harbor. It is ttached to the mainland by a low, arrow sandbar, the result of contant accumulation of sand that is eadily building up the western de of the outer Cape. Great Isnd's shore is made up of sand luffs overlooking a wide beach.

According to local informants, the scrub pine that covers much of the island today was planted as an erosion control in the 1830's. Because Cape Cod suffered severe deforestation during the eighteenth century, drifting sand had posed a serious threat. The condition of much of the outer Cape is vividly described in an 1802 history of Eastham, of which Wellfleet was once a part:

> Except a tract of oak and pines, adjoining the south line of Wellfleet, and which is about a mile and a half wide, no wood is left in the township. The forests were imprudently cut down many years ago, and no obstacle being opposed to the fury of the winds, it has already covered with barrenness the large tract above described, and threatens the whole township with destruction.

Although the historical evidence is not explicit, it seems likely that Great Island was separate from the mainland during the seventeenth and eighteenth centuries, and that during the eighteenth century at least, it was largely devoid of trees. A map drawn in 1795 shows the island completely separate from the mainland, as well as from Great Beach Hill, which today forms its southern end. It is difficult to tell just how deep the water was between Great Island and the mainland at that time. A letter written by Rev. Levi Whitman the year before seems to indicate that there were times when Great Island was truly an island and others when it was not, depending on whether or not high water actually covered the tidal flats between it and the mainland.

An 1831 map of Wellfleet shows wooded areas in the township, although by this date none of the small islands on the west side of the harbor is shown with tree cover. This map also shows Great Island to be separated from the mainland only by the narrow channel of the Herring River, which had its outlet at the island's northern end. Today, this channel no longer exists. It is blocked by dunes, and the Herring River empties into the harbor.

Whitman's letter also mentions dwellings on two of the other nearby islands. By its omission in this regard, it would seem likely that in 1794 there were no residences and probably no structures of any kind on Great Island. The 1831 map shows structures in Wellfleet in considerable detail. It indicates no structures on Great Island or on Great Beach Hill, but 13 on neighboring Griffin Island and 16 on Bound Brook Island.

In the remote past, however, there had definitely been human habitation on Great Island. Several Indian sites have been located there by National Park Service archeological surveys. These surveys also discovered the remains of some kind of structure, apparently built during the colonial period, on the easternmost end of the island. It was this site that became the focus of study and excavation during the summer of 1970.

It was decided to begin excavation in an area immediately adjacent to where we thought there might be a foundation, with the hope of finding enough material to provide some general idea of the site's age. This excavation revealed an extensive refuse-disposal area. Debris, forming a layer a half-foot thick, was covered with about ten inches of clean sand, probably deposited by wind action at a time when there was little or no tree cover on the island. The 24,000 artifacts recovered in this operation helped us to determine a reasonably precise date for the site.

Historical archeology relies on somewhat different evidence for dating sites than prehistoric archeology. Carbon-14 dating, in-

Aerial view shows the pine-covered sand bluffs of Great Island's headland (left foreground), where the tavern once stood, an invitation to sea-weary whalers. Great Beach Hill, separating Wellfleet Harbor from Cape Cod Bay, lies in the distance.

dispensable to the prehistorian, is of little use to historical archeologists since its degree of precision is not sufficient to pinpoint the brief chronological periods that historical archeology deals with. Historical archeologists try to derive more precise dates by studying artifacts.

Sites of English colonial settlements, for example, can often be dated by measuring the inside diameter, or bore size, of the white clay pipes that are usually found in profusion. Jean Harrington, an archeologist working at Jamestown, Virginia, discovered that the bore diameter of these pipe stems was reduced by $\frac{1}{64}$ inch every thirty years between 1590 and 1800, diminishing from a maximum average diameter of $\frac{9}{64}$ inch in the earliest examples to $\frac{4}{64}$ inch in late eighteenth-century pipes. Several thousand pipe stem fragments from the Great Island site had diameters predominantly of $\frac{5}{64}$ inch, indicating a date from 1710 through 1750, followed by smaller samples of $\frac{6}{64}$ inch (1680–1710) and $\frac{4}{64}$ inch (1750–1800). From this evidence alone, it appeared that the most intensive occupation of the site had been during the first half of the eighteenth century.

European pottery found in American archeological sites can usually be identified with close accuracy as to place of manufacture and date of production. The ceramics found in the initial excavations on Great Island coincided with the pipe stem evidence and provided some refinements. While the vast majority of the pottery found was redware, produced in New England and virtually useless as a dating aid, there were eight different types of English and German pottery in the refuse deposit.

North Devonshire sgrafitto ware, a distinctive incised brown-on-yellow pottery, and the remains of at least one large brown bellarmine stoneware jar manufactured in Germany suggested that the occupation of the site began late in the seventeenth century. Staffordshire mottled ware, a clouded and streaked brown pottery, usually in the form of mugs, and Staffordshire dipped-white salt glaze stoneware are both diagnostic early eighteenth-century types. Combed slipware, an attrac tively decorated brown-on-yello pottery, had its most popular pe riod between 1690 and 174 German blue-on-gray Westerwal stoneware, an ancestor of moder beer steins, and brown Englis stoneware are also characteristic o sites of the late seventeenth an early eighteenth centuries. So-calle delftware, with an opaque whit glaze decorated in blue and pol chrome painted designs, had its b ginnings in the late sixteenth ce tury in England. But it wa produced there far into the eigh teenth century, so its presence the site was of little help to us i determining precise dates.

Although they supported th early eighteenth-century date esta lished by pipe stem evidence, the eight varieties of European ceran ics indicated a slightly earlier b ginning date for the occupatio That the site was no longer fun tioning by 1750 seemed probabl because of the absence of a mor refined white salt-glazed potter made in the Staffordshire district England as early as the 1730's, well as the lack of other distincti types that were prevalent by the mi eighteenth century.

Both the pipe stem and ceram evidence suggested a date range ca. 1690 through 1740 for the Gre Island site. This date demolishe ie local tradition that the site was ie remains of an early seventeenth-entury Dutch trading post, since ie material we found was largely nglish and a century too late in me.

On the basis of the artifacts from ie refuse area, the possibility that ie site had once been a tavern eemed likely. There were many ine bottle fragments, thick dark-reen glass from squat bottles with eeply kicked bases. We were mazed by the abundance of broken ineglasses, graceful stemware with aluster supports, also characteris-c of the late seventeenth and early ghteenth centuries. Furthermore, a isproportionate number of ceramic agments were the remains of drink-ig containers, which might well ave been used to consume "good ip, good toddy."

With a secure date established id some idea about the identity of e building that had occupied the te, we began excavating in the ea we suspected the structural undation to be. This work was on rewarded. Clear outlines of one footings began to emerge, and nce Great Island is essentially a ige sand dune, all stone occurring ere must have been introduced by iman activity. The excavated undation had been little disturbed digging in the past, and in out-ie it distinctly revealed the ound plan of a large building. fty feet in length, and thirty feet width, it had faced south.

The floor plan was typical of ew England construction of the riod, and showed clearly a two-om arrangement in the main por-n of the structure. These rooms re located on either side of a rge brick chimney, the base of iich had survived. In addition to e bricks found in place in the eplace area, thousands of broken icks were found scattered in the cinity and in the west cellar. iese crudely made bricks were al-ost certainly manufactured some-iere in Massachusetts.

The front door was opposite the imney, facing south, with a ughly paved stone walkway lead-g to it. To the rear of the founda-n on the east side was another paved area, which probably floored a third room, covered by a leanto extending to the north. There is a strong possibility that this third room extended the full length of the north side of the building.

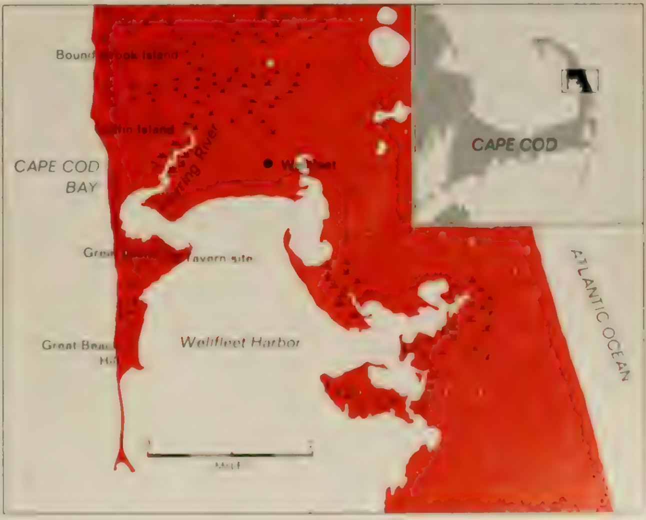
While each of the two main rooms had cellars beneath them, they differed in their manner of construction. The cellar under the east room was small (8 by 10 feet) and laid up with rounded cobbles set in mortar made from sand and clam or oyster shells. It was entered through a short stone stairway leading down from the south, or front, side of the house and was probably accessible through a trapdoor in the floor of the east front room. Its low height, under five feet, gave scant headroom.

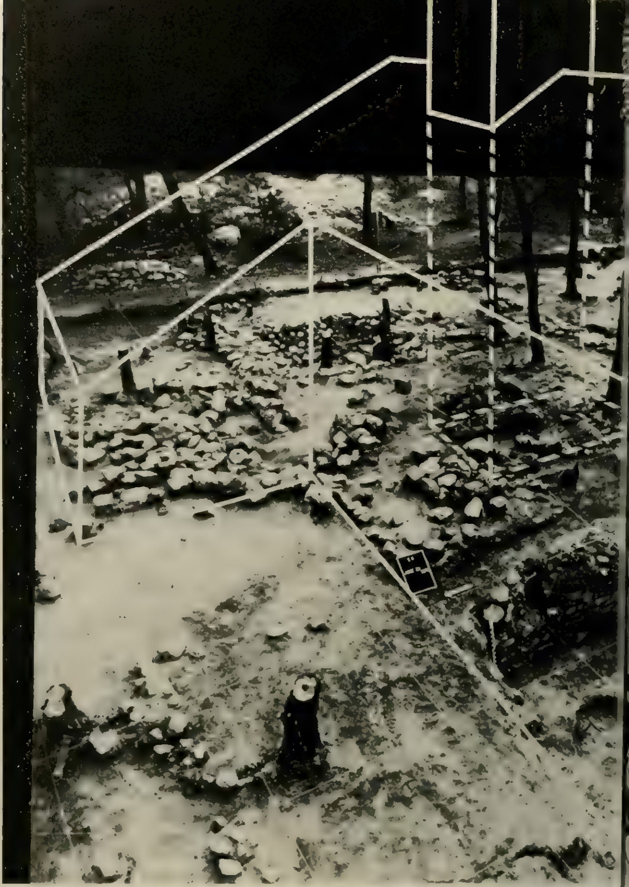
The second cellar was larger (9 by 12 feet) and, unlike the east cellar, had a sand floor in the center of which a shallow pit had been dug, for reasons unknown. The walls of this cellar were of rectangular stone laid in rather even courses. It must have been entered through a trapdoor by a ladder or wooden stairway, since there was none of stone. Both of these cellars were probably used for food storage and are similar to the cellars of farmhouses on the mainland at that time.

Numerous artifacts and bits of structural material in the vicinity of the foundation gave us considerable information about the building's construction. Nails were recovered by the thousands, showing conclusively that the building had been a wooden frame structure. It was probably two stories high, although there is no direct archeological evidence to support this. Surviving houses of this age and size follow a two-story plan. The windows were of thin, greenish glass with leaded mullions. Hinges and a latch lifter, showing the details of door hardware, turned up in the digging, as well as an iron key that would have been used in a metal lock.

One of the most interesting bits of architectural detail was provided by fragments of interior wall plaster. Richard Candee, a researcher of architecture at Old Sturbridge Village, has shown that Plymouth Colony evolved a unique tradition of building construction with no clear English antecedent. It was characterized by the use of vertical planks, or sheathing, to which clapboards were usually attached, so that the vertical members actually served as part of the structural framing in place of studs.

Until the Great Island site was excavated, there were no known examples of this type of construction from the Cape Code area of





A massive brick chimney (center of diagram) rose up between the tavern's two main rooms. All stone used in the foundation and the two cellars was brought from the mainland.

Plymouth Colony of seventeenth- or early eighteenth-century date. Here, the impression of horizontal laths, which held the plaster, is clearly visible on all the larger mortar fragments. In many cases, rust spots on the lath impressions indicate the presence and spacing of nails. In the space between the lath impressions, one can see the pattern and direction of the grain of the wood on which the laths were nailed. It runs at right angles to the lath direction, indicating laths attached by nails to vertical planks. Had the building been framed with studs, the majority of lath impressions would have shown no wood grain impressions behind the lath.

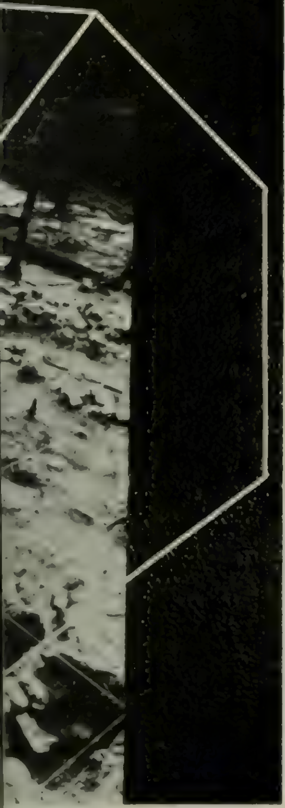
The building, then, was a large, two-story affair, clapboard covered, with typical late seventeenth- to early eighteenth-century diamond-shaped window panes. In all probability, it had a shingled roof with a massive brick chimney projecting through its center. Its large size and extensive ground-floor space would have been most suitable as a tavern for tired and thirsty visitors.

But who were these visitors? In one way, Great Island must have been quite isolated in the eighteenth century, and access to the island and the tavern could only have been by boat. Today, one has only to traverse a half mile of water at high tide to get to the site from the nearest shore point on what formerly was the eighteenth-century mainland. Land access, on the other hand, presently involves two and a half miles over difficult sand, and in the eighteenth century would have been further complicated by mud flats and tidal flooding.

Yet the people who frequented Great Island had a purpose in doing so. Certainly they were familiar with boats and the sea, and the short distance across the bay would have amounted to little indeed. As the foundation of the building was being excavated, evidence began to mount in support of a very special kind of activity on Great Island in the opening years of the 1700's.

The first indication came from the small east cellar. When excavated, we found it filled with clean sand with no artifacts in it. But directly on the floor in the southwest corner was a large, cervical whale vertebra that had been fashioned into a cutting block. Nearby was a large flipper bone and the base of another wine bottle. Whalebone, whether fashioned into artifacts or unworked, is not common on other English colonial sites in the Plymouth Colony area, but in view of the proximity of the ocean, the find was not entirely s
prising. It could have been a han
piece of whalebone picked up
the beach and put to good use.

As work proceeded in other ar
of the foundation, however, it
came apparent to us that it was
in the cellar by chance. More fr
ments of whalebone turned up,
when the west cellar was opened
was found to be rich in whalebo
Several dozen whole pieces
many more fragments were rec
ered, representing a number of
dividual animals. The culminat
discovery was the rusted foresh
of a small harpoon or lance. T
also came from the west cellar.
this point we were sure there
some connection between the
the building that had stood th
and whales and whale hunting.
turned to the historical record
order to find supporting docun



on, and had gratifying results. ,ong before the first great ships out from Nantucket and New lford in search of whales, New glanders had been a whaling ple. Aboriginal New Englanders e proficient whale hunters, aring them with wooden har- ns to which were attached floats t impeded the whale's progress. animal could then be sur- nded by canoes and dispatched h arrows. There is some question ether the first English whalers in area adopted aboriginal tech- ues or brought their own meth- with them. An account written 1613 describes Englishmen tak- a whale by securing the har- n line to a boat, rather than to a t, although the difference in- ved seems not too great. It is ally possible that the settlers on e Cod realized the obvious advantages of pursuing the whales, which could regularly be seen from the shore, and gradually refined their techniques for pursuit along the coast. However it began, whaling was an important activity on Cape Cod by the end of the seventeenth century.

In 1690, New Plymouth Colony appointed Inspectors of Whale whose duties included the inspection of drift whales—those washed ashore—to make certain that they were properly assigned to whoever had marked them first. Drift whales figure frequently in Plymouth court litigations during the second half of the seventeenth century. The discoverer of the whale received a third share of the animal, the Colonial government a third, and the town a third. The Inspector of Whale was also empowered to adjudicate the disposition of whales killed at sea and later washed ashore. A complex system of marking harpoons and animals evolved to provide proper proof of ownership.

One of the best descriptions of whale hunting on the Cape comes from *A Topographical Description of Wellfleet*, written by Levi Whitman in 1793:

> It would be curious indeed to a countryman, who lives at a distance from the sea, to be acquainted with the method of killing blackfish. Their size is from four to five tons weight, when full grown. When they come within our harbors, boats surround them. They are as easily driven to the shore as cattle or sheep are driven on land. The tide leaves them, and they are easily killed. They are a fish of the whale kind, and will average a barrel of oil each. I have seen nearly four hundred at one time lying dead on the shore.

Such a scene must have been quite commonplace on Cape Cod during the early decades of the eighteenth century. Both eastern Long Island and the Cape were leading centers in the development of shore whaling. It was a Cape whaler, Ichabod Paddock, who was brought by the people of Nantucket to teach them the best ways to kill whales and obtain oil. The flowering of later Nantucket whaling thus had its roots on the Cape.

Wellfleet was probably the community most committed to whaling on the Cape. Later in the eighteenth century, when whaling had developed into a deep-ocean pursuit, Wellfleet suffered more grievously than other Cape towns from Revolutionary War blockades, since its economy was so heavily based on whaling. Whitman's 1793 description ends on a note of reminiscence: "It is not however very often of late that these fish come into our harbor." As the whales moved out from the shore, possibly in response to the heavy toll taken by whalers, Wellfleet and other Cape towns apparently made a rapid conversion to deep-sea whaling. The situation had grown critical by 1727, and was described in the *Boston News Letter* on March 20 of that year:

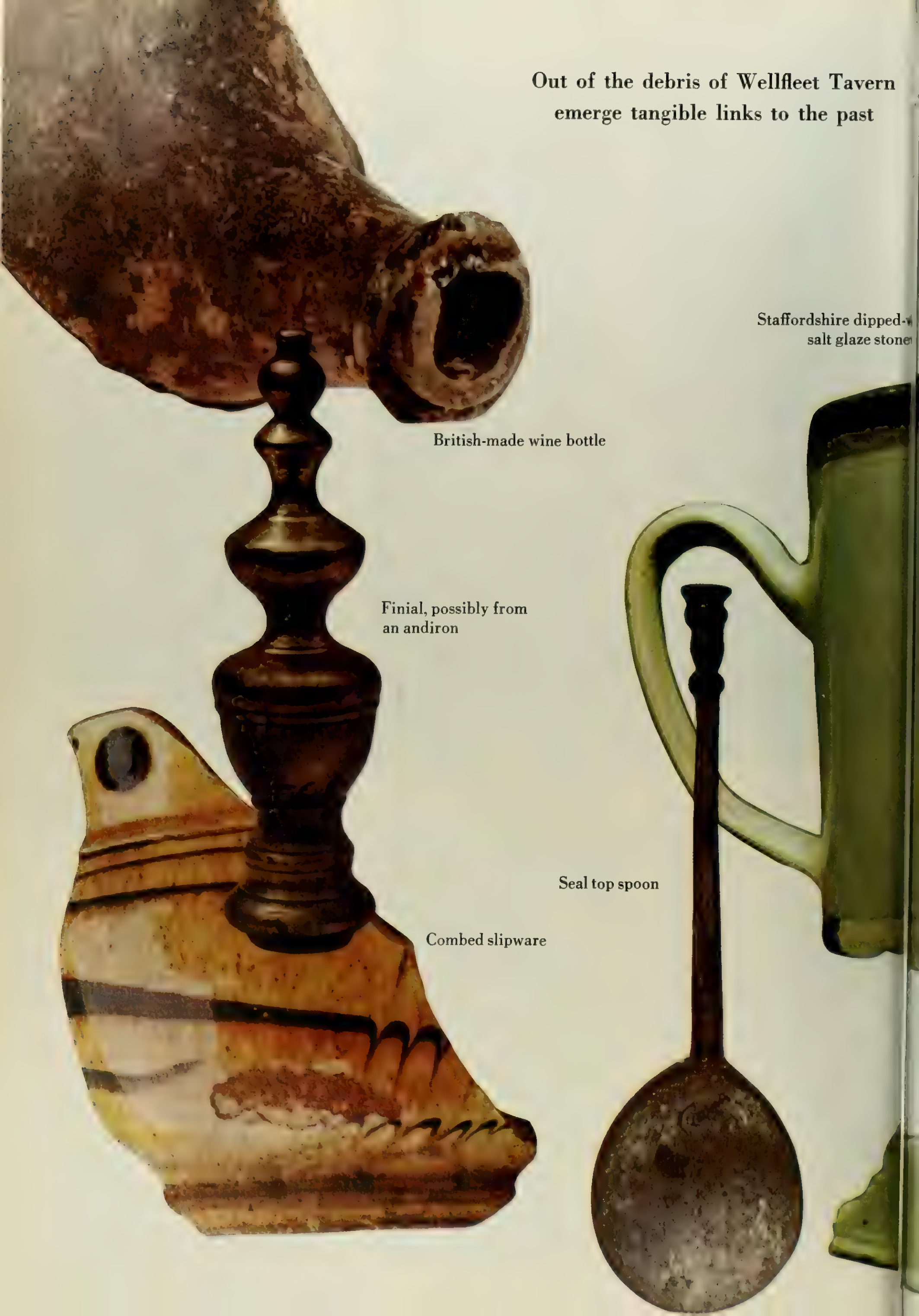
> We hear from towns on the Cape that the whale fishery among them has failed much this winter, as it has done for several winters past, but having found out the way of going to sea upon that business, and having had much success in it, they are now fitting out several vessels to sail with all expedition upon that dangerous design this spring, more (its tho't) than have ever been sent out from among them.

The golden age of American whaling had begun.

The parallels between the history of the development of whaling on the Cape and in Wellfleet and the evidence unearthed on Great Island are quite compatible. Whales were undoubtedly driven ashore on Great Island and butchered on the beach. Their flesh may have contributed to the bill of fare at the tavern on the bluff above, accounting for much of the whalebone found in the excavations. Regardless of how it found its way up the cliff and into the tavern, the large quantity of whalebone is eloquent testimony to the activities of Wellfleet shore whalers on the island. The tavern would have provided convenience and services to these people.

The dates of occupation and use of the tavern also agree closely with

Out of the debris of Wellfleet Tavern emerge tangible links to the past



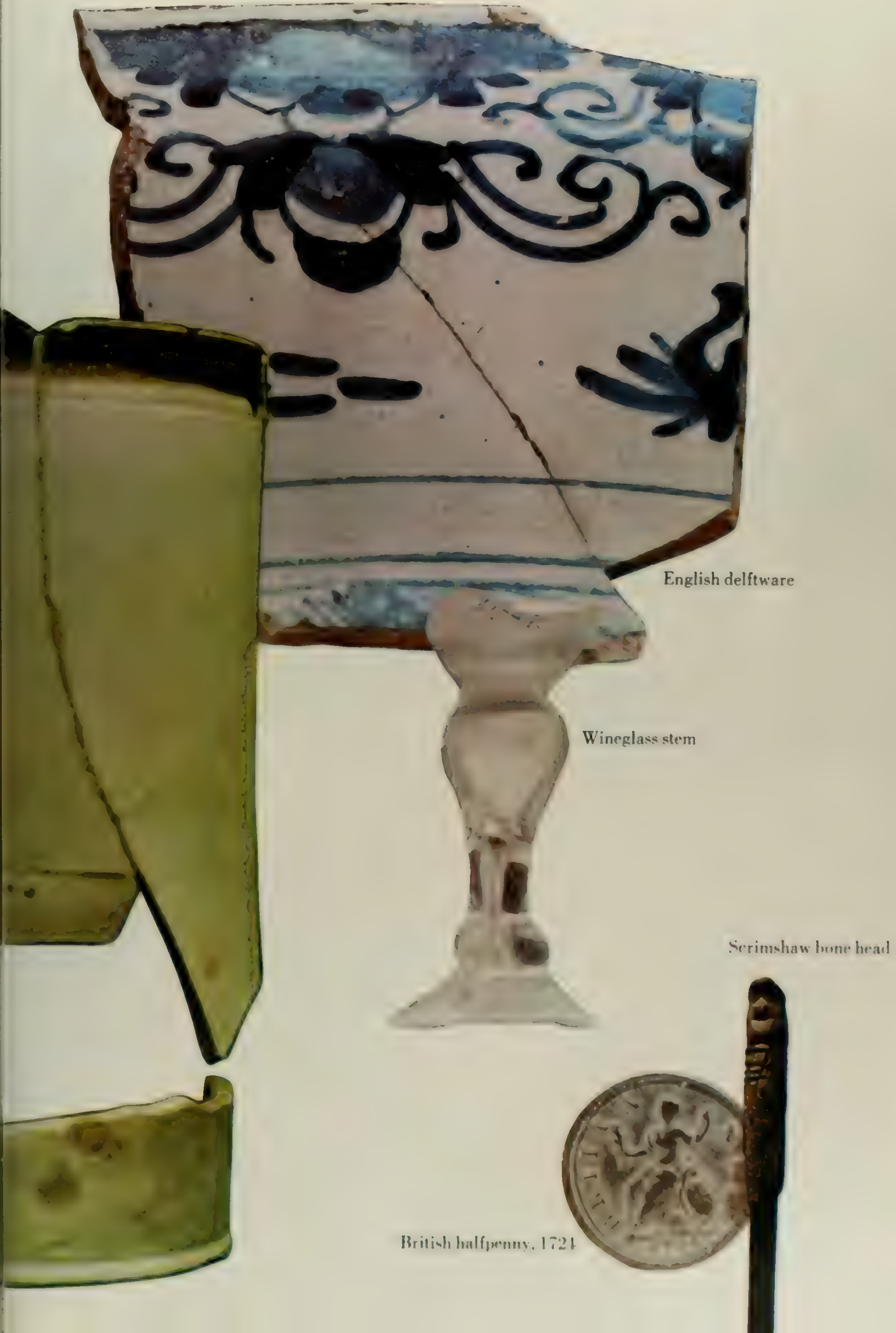
British-made wine bottle

Finial, possibly from an andiron

Combed slipware

Seal top spoon

Staffordshire dipped-
salt glaze stone


English delftware
Wineglass stem
Scrimshaw bone head
British halfpenny, 1724

the historical record. With the passing of shore whaling and conversion to deep-sea pursuit, the tavern might not have been as necessary. Archeological evidence suggests an end date of about 1740, and the *Boston News Letter* item shows that shore whaling was already fast fading in the area by 1730. Only a few years may have passed before the tavern, its clientele drastically reduced, was forced to close. By midcentury, the island was probably deserted.

In its heyday, the whaler's tavern on Great Island must have buzzed with activity. The building sat just back from the edge of the sea cliff, and lookouts stationed on high points in the vicinity would have spotted whales in the bay. The hours between whaling sorties were almost certainly occupied by partaking of the tavern's hospitality. The *Rose Tavern Scene*, engraved by Hogarth in 1735 as a part of "The Rake's Progress" series, conveys precisely the same sense of carousing as the artifacts recovered at the site.

Even the presence of friendly ladies is suggested at the Great Island tavern, for fragments of finely carved ivory fans turned up in the refuse and in the west cellar. True, they may represent fans owned by the lady of the house if there was one, but it is equally possible that they were owned and used by ladies who entertained the whalers at the tavern.

Scrimshaw was a traditional activity of the New England whaler. To while away the long hours at sea in search of whales, sailors carved intricate designs in ivory and bone. We found what may be the earliest piece of scrimshaw from New England in the refuse heap directly south of the tavern's foundation. Less than two inches in length, it is a carving of a man's head wearing a cap. It had been drilled at one end for attachment in some way or another, but we could not determine its function, if any. Too small to be the end of a knife handle, it could have served as a pipe-tamper ornament.

The most dramatic object we discovered was the frontal bone of a middle-aged European male, which was found in the fill of the west cellar along with quantities of whalebone, brick, and broken artifacts. It had a series of cuts and slashes along the area over the brows, which may have been what killed the man. It will probably never be possible to account for this grisly discovery with accuracy, but there is one interesting possibility. In 1717, the pirate Bellamy lost his entire fleet on the shore at Wellfleet. He had promised the captain of a snow (a small brig) captured the day before that he could have the vessel if he would only pilot the fleet into Cape Cod Harbor. The captain was suspicious of the offer and instead led the fleet into disaster, as described by Levi Whitman:

> The night being dark, a lantern was hung in the shrouds of the snow, the captain of which, instead of piloting where he was ordered, approached so near the land, that the pirate's large ship which followed him struck on the outer bar: the snow being less, struck much nearer the shore. The fleet was put in confusion; a violent storm arose; and the whole fleet was shipwrecked on the shore. It is said that all in the large ship perished in the waters, except two. . . . After the storm, more than a hundred dead bodies lay along the shore.

It may be that the scarred bone is evidence of this dramatic incident in Wellfleet's history. The date of the event is contemporary with the period when the tavern was being used. Or it could be the remains of some unfortunate local individual who became involved in a dispute at the tavern itself.

The foodstuffs consumed by the patrons of the tavern are evidenced by large quantities of shell and bone recovered during the excavations. Clams and oysters were eaten in vast quantities, so much so that the area around the tavern's foundation, particularly two refuse heaps to the north and south, resemble Indian shell middens. In fact, were it not for the European artifacts scattered in the fill, the site could be mistaken for one of aboriginal occupation. In addition to giving information on diet, the
animal bones provide further in
sights regarding Great Island's tree
less condition during the time o
the tavern's existence. The com
monest domesticated animal repre
sented by these bones is sheep, wit
only a few pigs and cows. On th
mainland during the same period
the wooded areas were much bette
suited to the foraging of pig
which were kept in greater numbe
there. However, if Great Island wa
grass covered in the early eig
teenth century, as the historic
records obliquely suggest, the
sheep would have been the mo
logical animals to keep on the i
land for a supply of fresh meat.

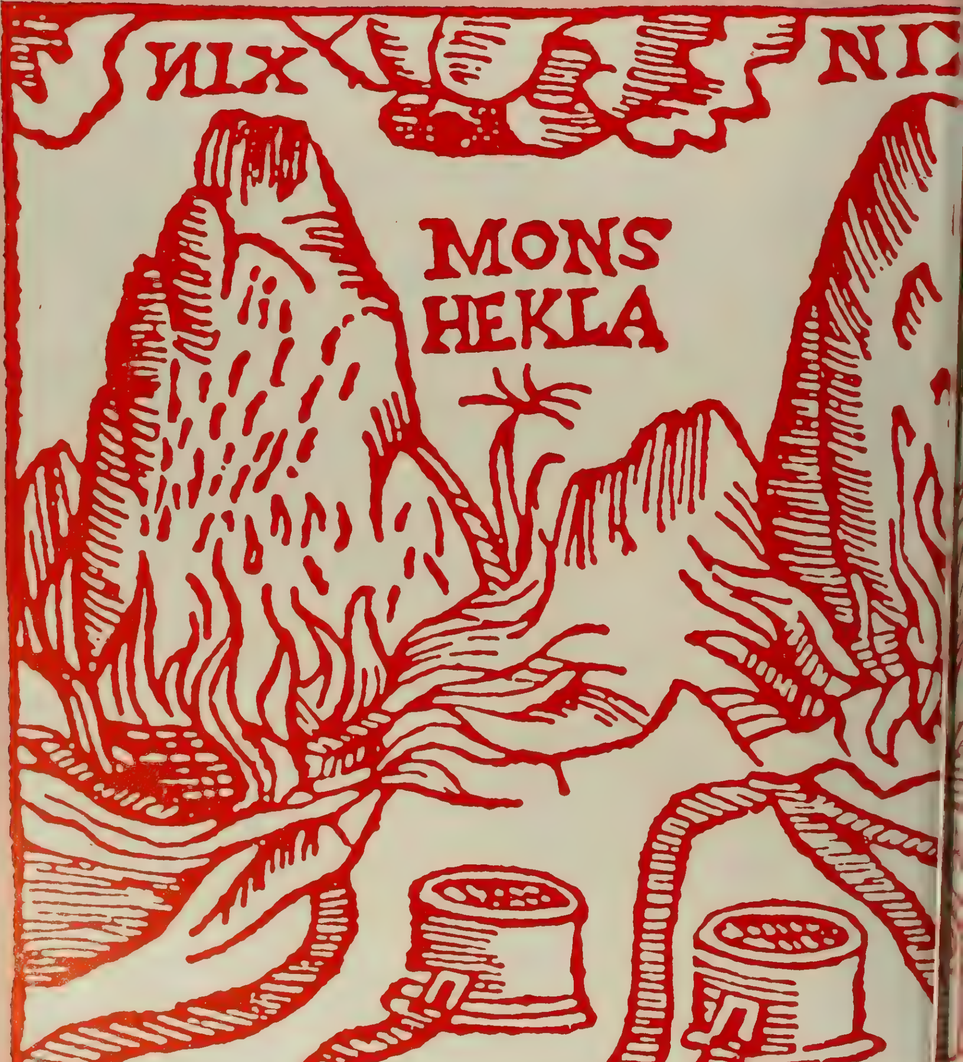
Archeology and history ha
combined in this study to pie
together a vivid picture of t
activities of the eighteenth-centu
shore whalers of Cape Cod. Alon
neither source of informati
would have been as complete as t
combined results. There is an i
mediacy of a special kind in vie
ing and handling parts of the wor
of another time, which is nev
sensed in working with the writt
records alone.

Great Island today is very diff
ent in appearance from what it w
in the eighteenth century. B
looking across to it from Wellfle
it is easy to imagine what it mig
have been like: a grassy emine
with a large building conspicu
on the high bluff, boats drawn
along the shore, and smoke risi
from the fires of the whale but
ers. When one stands on the si
with the ocean below and seabi
crying, its artifacts and ruins h
a special meaning bestowed up
them by the world of which t
were, and are, a part. The writ
record tells us of the past;
cheology confronts us with it, f
to face.

Archeologists sift
windblown sand that for t
centuries erased the mate
traces of the tavern's existen

Hellfire

by Sigurdur Thorarinsson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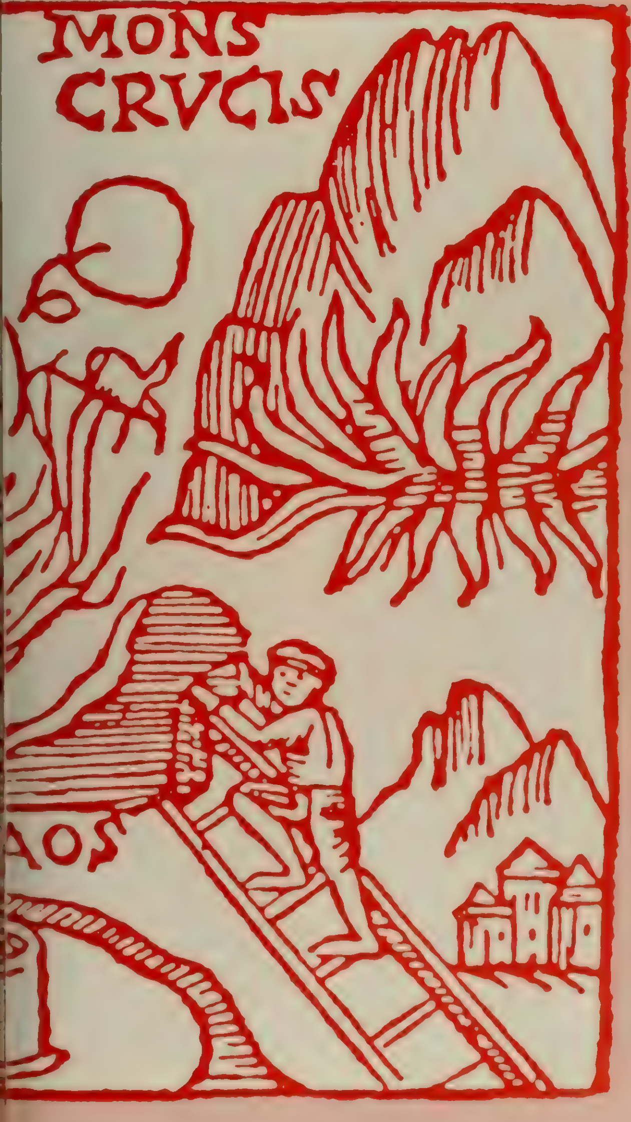
The exponents of damnation saw proof of an eternal fire whenever Mount Hekla erupted. Studies have shown, however, that hell is not underneath Iceland



The report, "Hekla on fire" has always evoked in Icelanders the same fear and wonder felt by people living in the vicinity of active volcanoes the world over. But soon after the first recorded eruption of Mount Hekla in 1104, this volcano was endowed with a supernatural aura beyond that usually inspired by volcanic activity.

The 1104 eruption—a particularly violent one, similar in type to the one that destroyed Pompeii in A.D. 79—devastated farms for a distance of 45 miles. Fifty years later Hekla erupted again, and before the end of the twelfth century, tales about this volcano had spread all over the Catholic world. These tales, frequently embellished along the way, were among the few bits of intelligence from isolated Iceland to which the rest of the world lent an ear. Eventually, they resulted in the widespread belief that by looking into Hekla's craters one could see the main entrance to hell. Presumably, if one looked hard enough, hell itself would be visible.

One of the oldest written references to Hekla is found in the *Book of Wonders* (*Liber miraculorum*), written in about 1180 by the Chaplain Herbert of the famous Cistercian monastery of Clairvaux. Having described a Hekla eruption and the terrifying inside of the volcano, the pious chaplain adds, with a note of triumph, "Who now is there so refractory and unbelieving that he will not credit the existence of eternal fire where souls suffer, when with his own eyes he sees the fire of which I have spoken." Traces of this belief lingered into the nineteenth century, and until recently it was common in Sweden to tell a person to "go to hell" with the words *dra at Hacklefjall*, which literally means "go to Hekla."

"Who now is there so refractory and unbelieving that he will not credit the existence of eternal fire where souls suffer, when with his own eyes he sees the fire of which I have spoken."

This notorious volcano, located 68 miles east of Iceland's capital city of Reykjavik, rises near the middle of the mountain crescent that encloses more than half of the southern lowlands. More accurately described as a vaulted ridge, Mount Hekla is about 3½ miles long, running northeast-southwest and split lengthwise by a fissure that opens up in its entirety during major eruptions. At present its height is 4,892 feet.

Through a combination of historical research and chronological study of volcanic deposits ejected during past eruptions of Mount Hekla, it has proved possible to determine the year in which each eruption since 1104 took place. These ejected materials, collectively known as tephra, include dust, ash, cinders, pumice, and boulder-sized lava bombs that are transported through the air and deposited at varying distances and directions from the volcano.

Studies of the chemical composition of Hekla tephra from dated eruptions, and the changes in the composition during the eruptions, reflect changes in Hekla's magma chamber. These studies reveal that the silica content of the magma in the uppermost part of the chamber slowly and continuously increases between Hekla's eruptions. This may be due entirely to gravitational differentiation of the fluid magma, resulting in a concentration of the lighter elements in the topmost part of the chamber. There are, however, some indicators, such as a rather sudden drop in the silica content of the tephra during the initial phase of some of the eruptions, that suggest assimilation of acid rocks in the roof of the chamber.

The increase of silica content and the gradual cooling of the magma in the chamber cause a building up of gas pressure. Consequently, the violence and explosiveness of a Hekla eruption are directly related to the length of the dormant period preceding each eruption. If Hekla remains quiet for two centuries or so, the eruption that follows is tremendously explosive and produces only acid tephra, whereas eruptions after shorter dormant periods produce both lava and tephra.

Hekla has erupted fourteen times since 1104. These eruptions have varied greatly in violence and duration, just as the intervals between them have been very uneven, ranging from 16 to 120 years. Damage from the lava flow has seldom been severe, but the destruction caused by the tephra falls has often been great, depending largely on the wind direction during the initial phase of each eruption.

After a dormant period of 101 years, Hekla erupted violently in 1947. Lava was produced in tremendous quantities, and fine-grained tephra ash fell on Finland two days later, having been transported 1,740 miles in the higher strata of the troposphere. The eruption lasted for 13 months, during which time it spewed forth more lava than any other eruption in this century, with the exception of the Mexican volcano Parícutin, 1943-52.

Since the eruption of 1597, the quiescent intervals, or reposes, between eruptions had increased steadily from 36 to 101 years, so the eruption that started at 9:23 P.M. on May 5, 1970, after a repose of only 22 years, was a surprise.

The initial phase of this eruption was far less violent than the previous one in 1947. The eruption column, however, did reach a height of 50,000 feet. The mair tephra fall lasted two hours, during which time the tephra uprush averaged 13,000 cubic yards per second, producing a total volume of 9 million cubic yards.

The tephra was carried north northwest and reached the nort coast of Iceland by midnight. Thi tephra was strongly polluted by fluorine, a gas that is released fror the magma during an eruption an adheres to the tephra grains mainl as hydrofluorine. Although th thickness of the tephra layer w only 1 to 5 mm., more than 7,50 domestic sheep died.

The lava flow during the fir hours of the eruption averaged 1 100 cubic yards per second, a within ten hours had covered thr square miles. Fountains and c umns of lava rose from the fissure glowing to a height of 3,000 feet l nightfall and providing a specta of fire and smoke against an in black-and-purple backdrop.

During the initial phase of th eruption, large amounts of xen liths, fragments of solid rocks, we brought to the surface. These xen liths may have fallen from the so roof of the magma chamber and l come embedded in the magma, they may have been torn from t conduit, or vent, walls by the u rushing magma and gases. Amo the Hekla xenoliths were a sign cant number of ignimbrites, fi grained silicic volcanic rocks co posed mainly of welded gl particles in which crystals of fe spar and quartz are embedded. nimbrites, which form thick, la like sheets, had never before b found in the vicinity of Hek They were similar to the igni brites formed in such eruptions the one that destroyed the city St. Pierre on Martinique w Mount Pelée erupted in 1902.

Information obtained fr analyses of the Hekla xenoliths likely to throw some new light the prehistoric record of Hekla a together with the study of the He lava and tephra, such infor tion should help us obtain a be understanding of the volca substructure. This understand will not suffice to predict with

exactness the start of a new Hekla eruption, but it could make possible a fairly accurate prediction of the volcano's behavior in future eruptions. Such a development would go a considerable way toward diminishing the damages caused by Hekla's eruptions and reducing the fear of the volcano that some of its neighbors understandably feel.

Another important fact is that the active volcanic zones of Iceland are a part of the Mid-Atlantic ridge and thus of the worldwide, mainly submarine system of ridges and rifts known as the World-Rift-System. This offers a rare opportunity to study many of the problems regarding the structure and development of this system, and to test arguments regarding the now widely circulated theory of ocean floor spreading. They may also help to determine whether Iceland is a typical part of the Mid-Atlantic ridge.

Hekla's eruptions no longer frighten the unbelieving from the ways of sin. The interest in the volcano as an abode of the condemned belongs to the past. But scientists have taken an increased interest in Hekla, investigating samples from its molten realm in pursuit of its secrets. Although they do not believe in the old legends, they cannot help but be thrilled, now and then, by the elemental fury and power of "Hekla on fire."

"Fountains and columns of lava rose from the fissures, glowing to a height of 3,000 feet by nightfall and providing a spectacle of fire and smoke against an inky black-and-purple backdrop."

THE RHYTHM OF THE FLOWERS

With clocklike precision, plants sense light and dark, and only when they get the right amount of one or the other do they flower

by John D. Palmer

One reason we have lilies at Easter and poinsettias at Christmas, rather than vice versa, is that these ornamentals flower only around these holidays. This is true of a great many plants in the middle latitudes, and subconsciously, we all have come to expect the appearance of bloodroot and buttercup in the spring, iris and columbine in the summer, and ragweed and goldenrod heralding the onset of the fall hay fever season. In other words, the time of year at which plants come into bloom is quite specific.

To the anthropocentric, this annual progression of various seasonal flowers is simply a manifestation of nature's design to keep our home and sickbed floral arrangements constantly changing. To early twentieth-century agriculturists, however, the control of flowering represented a problem to be solved, for if economically important plants could be made to flower and produce fruit earlier in the year, their range could be extended northward where the growing season was shorter. Maybe, for instance, oranges could be grown in New England.

In the search for the factor controlling seasonal flower production, temperature was one of the first variables investigated, for warmth was known to play a central role in plant growth and development. Because the most obvious physical changes in the environment during the growing season are associated with differences in temperature, it was only logical to suspect that each species flowered only in a particular daily temperature range, and that when this temperature was finally reached each year, it stimulated that species to flower. To test this hypothesis, the iris, which

The common house plant coleus requires nights of at least 12 hours before it will flower. Its leaves droop after dark in a regular "sleep-movement" rhythm.

The black-eyed Susans of summer are long-day plants; they flower only when the day length exceeds some critical length, usually more than 12 hours.

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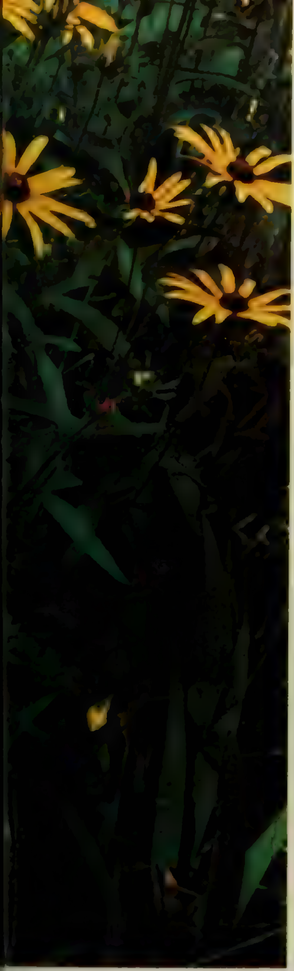
blooms in May and June, was grown in a hothouse in the winter, but although summer temperatures were mimicked, the plants did not flower until the following summer. Identical results were found with other plants as well. Temperature, therefore, was not the controlling factor.

The next variable tested was maturation time, the interval of growth and development required for plants to reach a state of maturity in which flowering can take place. Was it not possible that seedlings—like children—grew in size until "puberty" was reached and flowers could be produced? Because different species matured at different rates, they would naturally flower at different times of the year. To test this speculation, the Biloxi soybean, a plant that always flowers in September, was used. Seeds were planted in the early spring, again in June, and later in July. By fall, the spring plantings had gr
to heights of five feet or m
while those plants begun in J
and July had grown proportion
less. All bloomed simultaneousl
September, however, spectacul
demolishing that hypothesis.
date of germination clearly did
dictate the flowering season.

The first steps toward the
mate solution of the flowering p
lem were taken in 1918 at
United States Department of A
culture. Two government p
physiologists, Wightman Ga
and Harry Allard, working at
search station near Washin
were concentrating on ways of
proving tobacco production.



oblem at hand was a new variety
lled Maryland Mammouth. Aris-
g as a spontaneous mutation from
commercial variety of tobacco, it
ew to heights of from 10 to 15
t and produced as many as 100
more leaves on a single plant.
hile it grew well in the field, it
uld not flower and set seeds be-
re the onset of fall frosts. Cu-
usly, plants that were moved into
protection of a greenhouse just
fore the onset of cold weather
entually flowered in the late fall.
Garner and Allard elaborated
ny hypothetical explanations for
layed flowering in these plants,
ly to find them erroneous. Fi-
lly they asked the correct question: Could the time of flowering be determined by the length of day? Because of the tilt of earth's axis, the hours of daylight change greatly during its annual journey around the sun. For instance, in Washington there are 15 hours of daylight on June 21; but at the winter solstice, just before Christmas, this number is reduced to about 9½ per day. If a plant could measure the changing day lengths, it could time its flowering to a particular season of year, even to a particular week. This capability would explain why most species of plants only grow within a restricted range of latitudes and why they all flower at approximately the same date each year, for day length depends on latitude as well as season. If length of daylight was the answer, then Maryland Mammouth plants would eventually flower in the greenhouse because the greenhouse temperatures would keep the plants going until day length finally shortened to the proper duration, while their companions in the field would succumb to the cold.

To test this hypothesis, a lightproof building was constructed, and in July, at six o'clock each evening, Allard carried potted tobacco plants into the dark house, where they remained until eight o'clock the following morning. This treatment reduced the hours of daylight to ten each day, and within a relatively short time the tobacco flowered, while the control group living under the normal long July days remained in the foliage-producing state. This simple experiment conclusively identified the relative lengths of day and night as the factor controlling flowering! Because plants could indeed measure day lengths, the effect was first named "length-of-day response," but this cumbersome appellation was soon changed to "photoperiodism."

Following this pioneering discovery with tobacco plants, Garner and Allard turned their attention to the Biloxi soybean and found that by decreasing the daylight to just seven hours in May, they caused the bean to bloom in 26 days. Later tests showed that twelve hours of daylight were equally successful in producing flowering (unsurprisingly, the day length becomes twelve hours in September, when the soybean blossoms in nature). Continuing their studies, they found that even the traditional Christmas plant, the poinsettia, could be made to

Sweet clover is another long-day plant: it can be made to bloom during short days, however, by briefly exposing it to light in the middle of the night.

Ragweed, a short-day plant, grows poorly during the cool spring and is light inhibited during summer, so flowering is delayed until fall.

flower at any time of the year by daily exposure to light for just ten hours.

The converse experiment could also be easily performed: a plant that would flower only under relatively few hours of daylight could be subjected to "long days" to inhibit flowering. Such a plant, the cosmos, was placed in a greenhouse in early spring, and to extend "daylight," electric lights were left on from sunset to midnight each night. A second group that was left outdoors exposed to the normal short days of spring flowered within 50 to 60 days. All through the spring and summer no buds formed on the hothouse plants although they grew to a height of 15 feet. Not until October, when the greenhouse night light was turned off and the day lengths shortened sufficiently, did they finally flower.

In contrast to these spring- and fall-blooming varieties, another group of plants flowers only in the summer and obviously does not require short days. The radish is a typical example. Garner and Allard induced it to flower at will by giving it long days. (Incidentally, the intensity of the appended "daylight" need not be great; less than one-thousandth of full sunlight is sufficient.) Alternatively, by keeping the radishes under seven hours of illumination each day during the summer and then exposing them through the greenhouse windows to the short days of fall, winter, and spring, Garner and Allard kept the plants from flowering until the following summer when the days lengthened sufficiently. This treatment caused the radish, which is strictly an annual, to behave like a biennial.

At the end of their extensive first round of experiments, Garner and Allard were able to group plants into three main categories: short-day plants, long-day plants, and day-neutrals.

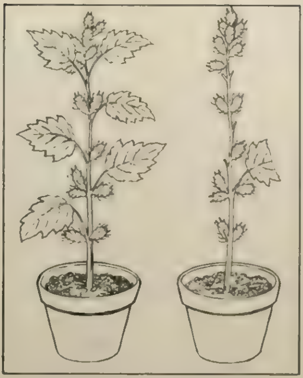
Short-day plants—such as asters, chrysanthemums, and soybeans—are those that flower when the hours of daylight are less than about 12 to 13. The members of this group that survive and can grow at relatively low temperatures will bloom in the early spring; but the majority of the short-day group, and especially the annuals, do not develop flowers until the summer and fall.

Hollyhocks, black-eyed Sus irises, and sweet clover are ex ples of long-day plants; they flo only in response to day lengths ceeding some critical length (usu more than 12 hours). They bloo late spring and early summer.

A third major group, the neutrals, like the tomato, rose, nasturtium, is not choosy about lengths and flowers profusely ov wide range of photoperiods w other environmental conditions propitious.

In the chronology of discovery,
next question asked was, What
rt of the plant is it that "senses"
changing day length? Cockle-
r, a ubiquitous noxious weed, was
osen as the experimental tool
cause it had been found to be a
rticularly discriminating plant: it
ild tell the difference between
ht hours of darkness (which had
pullulating effect) and eight
urs and forty minutes (which
used flowering). The experiment
s simple and to the point: the
ves were stripped off one plant
l left in place on a companion;
h plants were subjected to nine-
ur nights. The divestment pre-
ded flowering, although the plant
otherwise in fairly healthy con-
ion. If only one-eighth of one
was left on an otherwise
pped stem, burrs would develop
mally in nights of nine hours.

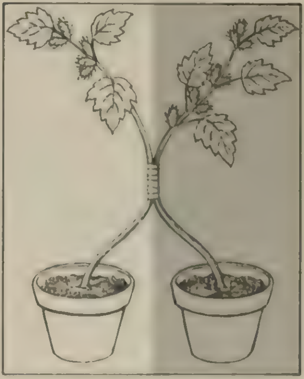
Because the leaves are often re-
te from the points of the stem
re flowers are formed, the exis-
e of a traveling stimulus is sug-
ted. To test this speculation two
klebursl were grafted together at
bases of their stems. One of the
joined members was now ex-
d to long days (which, remem-
inhibit flowering in the cockle-
) and the other given short
s. Both plants flowered. The ex-
ment was repeated, this time
a piece of absorbent paper in-
ed into the graft between the
its. Again, flowering occurred in
. In a further test it was found
even grafting a single leaf that
previously been exposed to
t days onto a plant maintained
long days proved a sufficient
ulus. Certainly some substance
being manufactured in the
es and transported (even diffus-
across a paper barrier in a
t union) to potential flowering
ts on the stem. This peripatetic
ulus has been called florigen,
while it has not yet been iso-
l for sure, it is demonstrably
ent in most vascular plants. It
apparently identical in com-
tion from plant to plant, for
ting experiments between dif-
nt species, families, even be-
en long- and short-day varieties
e all succeeded.



Given at least 8 hours and 40 minutes of darkness, the cocklebur will develop burrs. When all the leaves are stripped from the plant no burrs develop, but if even one-eighth of one leaf is left, burrs will develop.

Early in the study of photoperiodism, a rather surprising discovery was made. It had seemed reasonable to conclude that if a plant needed a certain number of hours of daylight to flower, then darkening it for an interval of time during the day should disrupt the response. Temporary blackouts, however, were found to have no effect. More surprisingly, when the opposite was done—turning on the lights for a short interval in the middle of the night—the flowering response was altered. Brief periods of light during long nights inhibited flowering of short-day plants, and when long-day plants were kept from flowering by maintaining them in short days, a light break in the middle of the dark period promoted flowering. To everyone's surprise and chagrin, the plants were responding to the length of the night rather than to the day length. The neologism *photoperiodism* was a misnomer: short-day plants were truly long-night plants, while long-day specimens were actually short-night plants.

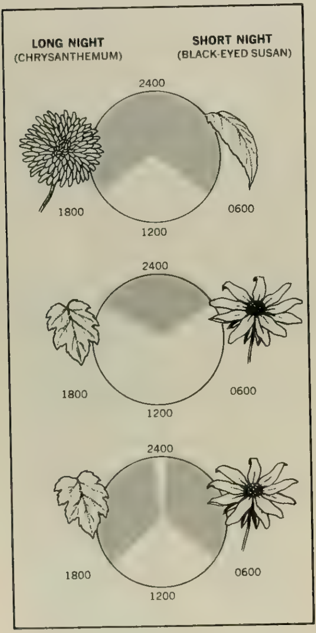
The discovery of the effectiveness of a short pulse of light interrupting the darkness opened up a new direction of inquiry. To bring about an effect on a biological system, light must first be absorbed by a specific protoplasmic substance—a pigment. For example, in man the pigment rhodopsin absorbs light in the eye; in green plants the important pigment is chlorophyll. After absorption a chemical mechanism is set to work and a response elicited, vision or photosynthesis in the previous examples. Clearly, a first step in studying a photochemical event is to ferret out the pigment involved. To do this, visible light was channeled through a prism that split it into its spectrum of color bands, each with its own specific wavelength. Then the middles of the dark periods of long- and short-night plants were briefly interrupted with lights of different wavelengths. Red light with a wavelength of 660 nanometers (0.000026 inches) proved most effective in altering the plant's response. It was also found that if the flash of red was followed



Two cockleburs are grafted together to prove the existence of a traveling flowering stimulus. The plant at left was given long days, which normally would prevent flowering. The plant at right was given the necessary quota of darkness. Both plants developed burrs, showing that the stimulus had crossed the graft from one plant to the other.

immediately by a short interval of far-red (still redder) light (with a wavelength of 730 nanometers), the effect of red light was canceled out. Then the plants acted as if their nighttime had never been interrupted at all.

These results indicated the involvement of two bluish pigments (the complementary colors to the absorbed reddish wavelengths). As it turned out there was but a single pigment, now called phytochrome, which exists in either of two states: one in which it absorbs the red light, and the other in which it absorbs the far-red. When extracted from plants it was indeed found to be blue-green in color, but, because it is present only in very low concentrations in the plant, it is not visible to the naked eye.



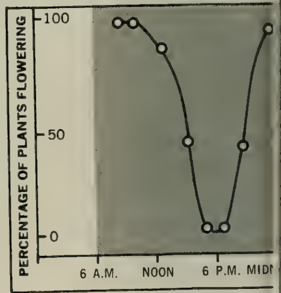
These 24-hour clocks show the effects of different periods of light and dark on long- and short-night plants. At top is a long night; it produces flowering in long-night plants and inhibits it in short-night plants. At center, a short night produces the opposite effects. At bottom, a brief light period in the middle of a long night produces the effects of a short night.

When red light strikes a plant in the middle of the night, the red-absorbing form of phytochrome absorbs it, and at least two changes take place: the pigment is converted to the far-red absorbing form, and this conversion initiates the metabolic machinery that inhibits flowering in the long-night plants and promotes it in short-night members living in long nights. If, however, the red illumination is immediately followed by far-red light, the latter is absorbed by the far-red form of the pigment, which is then converted right back to the red-absorbing form before any significant physiological changes can occur. Flowering is therefore not affected. Although the discovery of phytochrome was a giant step in the decipherment of the entire flowering mechanism, we still do not know how these primary photochemical events are coupled to the rest of the flowering machinery.

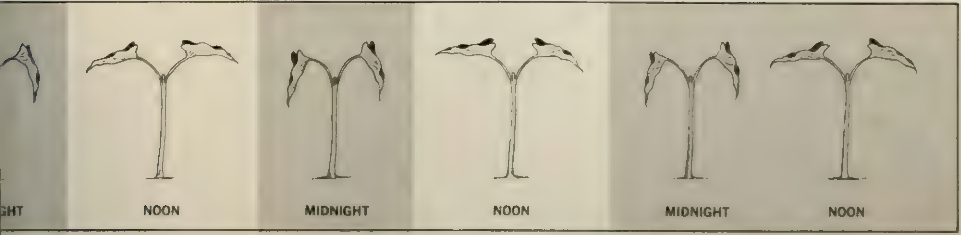
Finally, we move to the most mystifying aspect of the flowering process: By what yardstick do plants measure the length of night? All organisms are provided with their own physiological "clocks," which are known to control some features of their temporal behavior. We suspect such clocks also function in the measurement of the dark period. To better appreciate this, consider the general subject of living clocks.

Many physiological functions in most plants and animals—including man—are under the control of the organism's inner clock, which causes these functions to vacillate quantitatively over the period of a day. Highs in these processes are repeated with such beatlike regularity that the physiology is referred to as rhythmic (*see* NATURAL HISTORY MAGAZINE, March, 1966; February, 1967; April, 1970). For example, there is a well-defined rhythm in man's body temperature—it is highest in the afternoon
and lowest in the small hours of t
morning—98.6°F. is only a dai
average. Mice, rats, and coc
roaches are active at night a
sleep during the day; most bir
are just the opposite. Many bea
crabs are active during the times
low tide but remain in their b
rows at high tide. Honeybees se
out nectar only at specific tin
each day. A multitude of other
amples can be listed in the anin
kingdom.

In vascular plants there are m
than fifty known rhythmic pr
esses, including photosynthe
metabolism, nectar producti
growth, cell division, and the op
ing and closing of flowers. (
rhythm, the first ever observed
man, which I will describe in de
because it will play a direct role
the discussion of flowering, is
sleep-movement rhythm. M
plants, particularly the legur
lower their leaves to the sides
their stems at night, but lift tl
again each day, as if in pagan t
ute to the rising sun. This behav



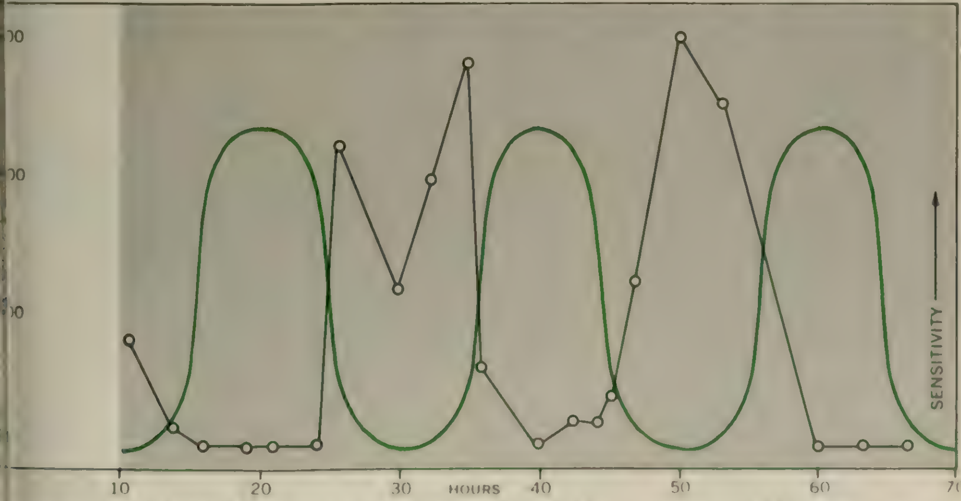
This curve shows what
happens to a long-night pl
when its 16 hours of dark
are interrupted by short
periods of light. Each dot
represents a light period.
Its vertical position shows
what percentage of the pl
flowered. Flowering is not
affected by light periods
near the beginning and en
darkness, but is completel
inhibited by light periods
10 to 11 hours after the
onset of darkness.



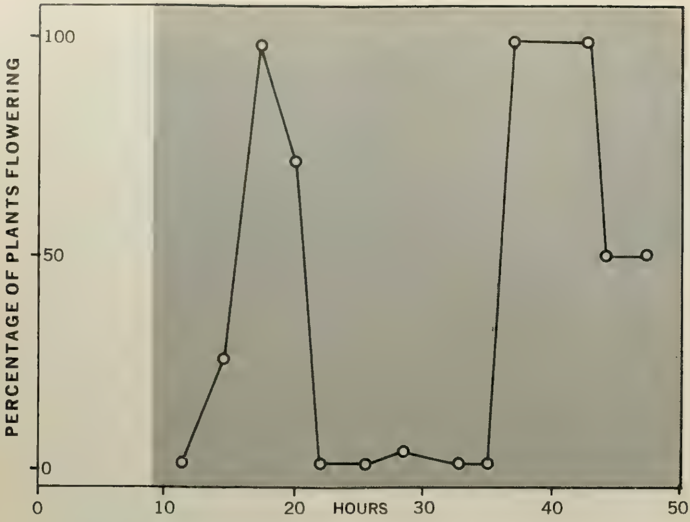
he leaves of a bean seedling droop during the night and stand up during the day. The ant follows this daily cycle even when it is kept in continuous darkness.

pecially bizarre for a plant, was st recorded 300 years before the th of Christ. As if it were not ange enough that a vegetable had power to move, the plants possed an even more paradoxical perty: the up-and-down movents of the leaves that were so exly tuned to day-night changes t they must be governed by m—were not! When the plants re brought indoors and kept at a stant temperature and in contins darkness (no more light and rmth signaling daytime, no more l darkness of night) the leaves tinued their rhythmic sleep vements in approximate synchrony with their companions in nature. In the laboratory, the plant's biological clock was obviously dictating the rhythm with accustomed precision in spite of the unnatural, aperiodic environment. All the other above-mentioned daily rhythms also persist in constant laboratory conditions, indicating that they, too, are despotically ruled by the living clock.

In focusing now on the use of the clock in measuring night lengths, I will begin by pointing out that the earlier statement about the disruption of flowering by a flash of light during the dark period is misleading in that it does not tell the full story. If the period of darkness of a long-night plant is interrupted at times other than the approximate *middle*, inhibition of flowering is not complete. The details of this type of experiment are important. A large group of long-night plants are kept under cycles of eight hours of light alternating with sixteen hours of darkness, a lighting regimen that induces flowering. One subgroup is given a 30-minute light exposure, beginning one hour after the onset of darkness, for several consecutive nights. In a second subgroup, the 30-minute light exposure is begun three hours after darkness sets in. In the next group the flash



another test of long-night plants, short periods of light (dots) interrupted 62 hours darkness. At certain times the light periods had little effect; at others they almost npletely inhibited flowering. The times at which light inhibited flowering can be regarded the times when the plants are most sensitive to light. These times are almost exactly hours apart. Superimposed is a second curve (color) that indicates these peaks of sensitivity.



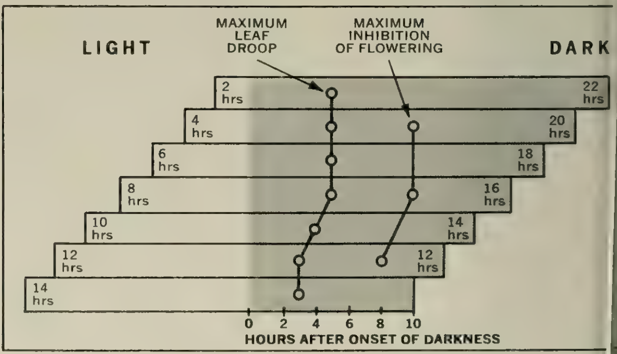
When a short-night plant is kept in the dark, short light periods can promote flowering. Here again the peaks of flowering (presumably times when the plants are most sensitive to light) occur about 24 hours apart.

is begun five hours after darkness, and so on, until the entire dark period has been systematically explored with light breaks. When the effects on flowering are plotted, it can be seen that identical light treatments (each 30 minutes in duration and of the same intensity) have no effect during the first and last few hours of darkness, but at other times flowering is impeded or completely prevented, depending on the specific time that the light was offered. This type of experiment dramatizes the fact that within the plant there is a changing sensitivity to a light interruption during the nighttime.

To examine this finding in more detail, a long-night plant was given very unnatural "day-night" cycles: 10 hours of light alternating with 62 hours of darkness. This unlikely combination, which totaled three days in length, proved to be quite effective in bringing on flowering. Now, in the same manner as described before, the dark period was systematically probed with short light breaks (two minutes each in this case), and again flowering was inhibited at some times but not at others. As seen in the figure on page 71, quite visible in the inhibition pattern is a wave form with peaks approximately 24 hours apart, indicating that the response is rhythmic. This suggests that the flowering response is, in turn, controlled by rhythmic changes in the plant's sensitivity to light. This h pothetical light-sensitivity rhythm superimposed over the figure and characterized by peaks durir which light inhibits flowering, alte nating with segments in which ligl has no effect.

Similar results have been foun in short-night plants. A group w given a cycle of 9 hours of ligl alternating with 39 hours of dar ness, a combination that inhibit flowering. Then the prolonged da period was interrupted at successi intervals, and the effect on flow ing observed. Again it was fou that flowering was promoted some times but not at others a that the peaks of maximum pron tion fell at 24-hour intervals—mi icking the underlying rhythm light sensitivity.

Another way of elucidating clock's action in the flowering p cess is to alter a known pl rhythm in some manner and lo for concurrent and similar chan in the "photoperiodic" respor This approach has been used Ruth Halaban at Princeton Uni sity, working with the comn house plant coleus, a long-night riety whose leaves undergo a v precise sleep-movement rhyt She divided her plants into se



Coleus, a long-night plant, was subjected to various proportions of light and dark. With light periods of up to 8 hours, the leaves drooped the most 5 hours after the onset of darkness, and the strongest inhibition of flowering (by short bursts of light) came another 5 hours later. When the light period grew to 12 hours, both response advanced 2 hours closer to the onset of darkness.

ıps and placed them under arti-
l 24-hour days in the labora-
. Group 1 was subjected to
es of two hours of light alter-
ng with twenty-two hours of
: group 2 received cycles of
hours of light and twenty
rs of dark, and so on up, the
th of the light period being in-
sed by two hours in each suc-
ing group to a maximum of
teen hours of light and ten of
. in group 7. After each group
lants had lived for a while in its
peculiar light-dark cycle, Hala-
carefully noted any alteration
the plants' sleep-movement
hm. She found that the time at
h the leaves drooped max-
ly came five hours after the on-
of each dark period, in light–
cycles ranging between "2
:22 dark" and "8 light:16
," but only three hours after
s off in the groups receiving
ve or fourteen hours of light.
is, under longer day lengths.
leaves "retired" earlier, so to
k.

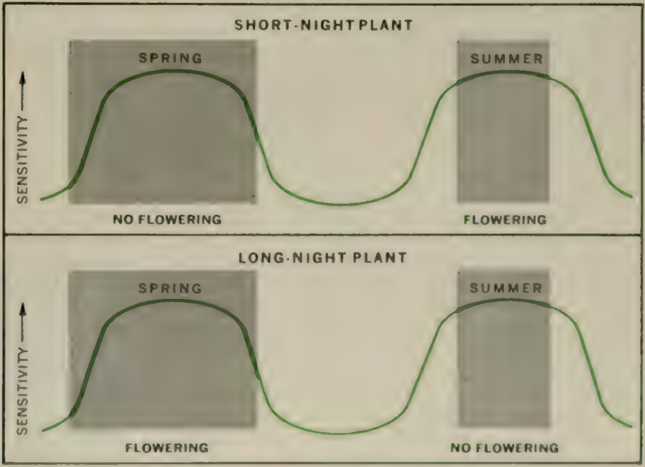
ıis long-night variety will
r if the nights are no shorter
twelve hours, so all the above
dark conditions except those
sed on group 7, are capable of
ging on blossoming. Next Hala-
performed the corollary ex-
nent. She divided her plants
three groups and placed them
24-hour cycles with either four,
t, or twelve hours of light and
probed the hours of darkness
light breaks in the customary
looking for the times of max-
flower inhibition. In groups 1
2 this maximum came ten
s into the dark period, while in
p 3 it came only eight hours
the onset of darkness.

ıese two experiments with
ls again suggest that a rhythm
volved in the flowering process.
asing the length of daylight
ged both the time of maximum
droop of the sleep-movement
ım, and the times of maximal
ition of flowering. If a treat-
brings about the same re-
se in two different systems, one
hich is known to be a clock-
olled rhythm, it certainly sug-
that the other system must also be associated with a timed rhythm.

The inescapable conclusion of these last experiments is that a clock-controlled light-sensitivity rhythm plays a predominant role in the flowering responses of long- and short-night plants.

I have diagramed this sensitivity rhythm (see below), but must emphasize that this is only a hypothetical representation, and while it is somewhat similar to reality, it is probably an oversimplification and must be treated as such. In the curve portrayed, twelve-hour light-sensitive phases alternate with twelve-hour insensitive ones (in nature the relative lengths of these phases and general form of the rhythm will differ between species and under various lighting conditions). The hours of daylight in spring are of such short duration that they illuminate only the insensitive phase of the rhythm in short-night plants; but as day lengths increase with the approach of summer, the sensitive portion is also illuminated, which of course, causes the plants to bloom. In the case of long-night plants, long summer days overlap with the sensitive phase of their rhythm so that they do not flower. In spring or fall this segment is not exposed and the plants burgeon if mature.

The seasonality associated with flowering is a consequence of several circumstances coupled to a number of complicated plant processes, some of which are still unknown. The phenomenon begins with visible light from the sun falling on the plants and the red wavelengths in particular being absorbed by the phytochrome. This initiates a photochemical event in the leaves that, if the plant is in the response segment of its clock-controlled light-sensitivity rhythm, initiates florigen synthesis in short-night plants, but inhibits it in long-night varieties. The results are crocuses in spring, pansies in summer, and asters in autumn.



The hypothetical rhythm of light sensitivity is shown by the curve (color) in both parts of the diagram. The upper figure shows the effects of long and short nights (shading) on short-night plants; the lower figure does the same for long-night plants. The critical factor is light striking the plant at or near the peak of its sensitivity curve. This produces flowering in short-night plants and inhibits it in the long-night variety. A third class of plants is indifferent to the length of the day and night.

Sky Reporter

What Next in Space? The future of United States manned space flight, not to mention quite a few billion of the taxpayers' dollars, is being settled right now in little-publicized debates over the relatively innocuous millions being sought for "development" of future space vehicles. Debate is centered around the space shuttle, a reusable vehicle designed to get more into orbit for less money.

The camel's nose is in the tent already. A $600 million contract is to be awarded just about now for development of the engines, and next spring development of the vehicles themselves will get under way. President Nixon asked for $100 million to be spent on the shuttle in fiscal year 1972, which began July 1.

As things stand, the current program of United States manned flight in space will end in 1973. The last Apollo mission to the moon is scheduled for late 1972, and after that, the only flying will be in the earth-orbiting Sky Lab. Three-man crews will fly in the Sky Lab for a total of eight months. When the last man comes down, the United States will have finished all the manned flights for at least six years, and possibly much longer. No one outside of NASA is talking of manned flight to Mars, and no one in NASA can put a date on such a flight, which would involve two-year voyages by nuclear-powered ships.

The space shuttle, which could be test flown by 1978, would provide "airline service" into earth orbit. It is being promoted as a launch vehicle, but is also a necessary intermediate step to larger ventures.

As a reusable launch vehicle, the shuttle makes sense. All current vehicles are rockets that are used only once. Imagine what it would cost to fly across the country if the airlines used a 747 only once. The best we have done to date with launch vehicles is the Saturn 5, which puts a payload into low earth orbit for $800 a pound. The shuttle will put a pound of payload into orbit for $100 or less.

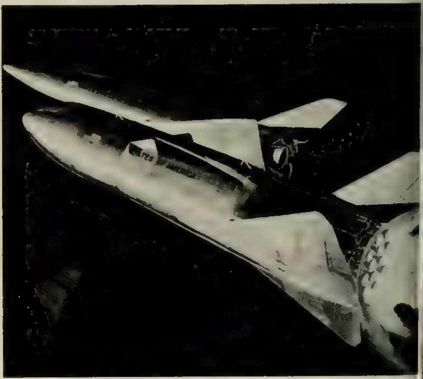
And the payloads themselves can be cheaper. Now they have to be miniaturized to fit in a nose cone, and built to withstand tremendous acceleration at lift-off. With the shuttle, a payload 60 feet long and 15 feet wide can be accommodated, and the launch acceleration is far less violent.

The shuttle can also guarantee that a $75 million satellite does not fail in orbit for want of a horsesl nail. Technicians can check them just before they placed in orbit, or fly up and repair them in orbit. ultimate could come when a scientist would carry experimental package aloft in his lap and, once in bit, simply open a hatch and gently lob his baby i space. A year or two later he could go up and get it.

Satellites could be reused. Some of them are so pensive that it would be cheaper to bring one do overhaul it, and put it back up than it would be build a new one.

The shuttle is a simple concept, but it may harder to design than anyone connected with it ant pates. It consists of two rocket planes, each equip with rocket engines, wings for landing like a pl and conventional jet engines for moving from one port to another.

On takeoff, the smaller vehicle, the orbiter, is mo ed on the back of the larger vehicle, the booster. dimensions, they would correspond roughly to a jet strapped on the back of a 747. The booster wo be sitting on its tail, and would take off vertically a rocket. At an altitude of about 40 miles, when



A space shuttle heads for earth orbit.
About 40 miles up the smaller orbiter will separate and fly the rest of the way alone.

em had reached a speed of some 7,000 miles per
, the two would separate, the booster to return for
nding and the orbiter to turn on its engines to
h an altitude of 100 miles and a speed of 18,000
s per hour.

he orbiter would be able to stay up for seven to
days while the crew checked satellites and placed
in orbit, repaired or modified satellites already
rbit, performed scientific work directly from the
ter, exchanged crews at a space station, or what-
the mission called for. Then it too would return
arth, landing like a plane. Two weeks after land-
the shuttle vehicles would be ready to go again.

uttle flights would still be wildly expensive—in
neighborhood of $5 million per trip. But they
d be substantially cheaper than current methods
unching satellites. To put a payload into orbit
a Titan 3C costs more than $20 million.

e design problem is to create hybrid rocket
s that can take off like ballistic missiles and land
airplanes. NASA believes the shuttle vehicles can
signed and prototypes built for about $9 billion.
g with a space tug for moving payloads into
er orbits and the necessary ground facilities, the
development bill is estimated at $12.7 billion.
cs in Congress say this could easily reach $25
n, the cost of the entire Apollo moon program, if
esign proves to be more difficult than anticipated,
nmon occurrence in the development of new civil-
nd military aircraft.

e cost is the principal objection to the shuttle
ram in Congress and elsewhere. "Nice, but not
" is the reaction. Once the shuttle is built, it ap-
inevitable that pressure will be exerted to make
mum use of it for building large space stations in
around the earth and the moon, and later on to
nble Mars ships. Many congressmen just do not
to let these projects build up any momentum.

her objections concern military applications of
shuttle. Until now the space agency has been a
an agency, with few public ties to the military.
satellites and other Defense Department space-
are launched from an Air Force base on the
Coast, far from the glare of Cape Kennedy. The
le, however, would replace all Air Force launch vehicles, and is being designed with Defense Department requirements in mind.

Many scientists have serious reservations about NASA claims for scientific work that could be done on 10-day shuttle missions. They were upset by the cancellation of three of the Apollo flights with the most scientific potential, and point out (bitterly, in some cases) that at best only one of the scientist-astronauts will get to the moon, and no more than three will even get to Sky Lab.

To date, the United States has invested $150 million in the shuttle program. If it continues, the final bill will be at least 100 times that much. So far the public has shown little interest in the debate. But the time to say yes or no is not in 1978, when the shuttle is ready to fly, but now.

Fireball Postscript In the April issue, I passed along the predictions of two British astronomers that the weekend of April 24 might be a good time to watch for fireballs. They had computed the orbits of two recent fireballs, decided the orbits could be identical, and concluded that there might well be more each year when the earth crosses the metoroids' orbit every April 24.

At least one reader did see one. James A. Lewis of Merrill, Wisconsin, reports he and his wife saw a fireball over Monico, in north-central Wisconsin, at about 2 o'clock that Sunday morning. Their attention was caught when Mrs. Lewis heard a thunderlike sound and Mr. Lewis heard static on the radio. "I thought it was lightning," he writes, "until I looked up and saw the fireball-like object hurtling northerly through the clouds. It seemed to break up about 30 degrees above the northern horizon." It was accompanied, he said, by "a sputtering sound and a lightninglike effect in the cloud-covered sky."

Whether this fireball is really related to the two discussed in April remains to be seen. If enough people saw it, its orbit can be computed and compared with the others. At the very least, the Wisconsin fireball is a likely candidate: it was seen at the right time, moving in the same direction as the last two. Now we will see what happens next April 24.

JOHN P. WILEY, JR.

Celestial Events

With new moon on August 20, expect an evening moon through the end of the month and into early September, with first-quarter on August 28, and full moon on September 4. The moon then moves into the morning sky, with last-quarter on September 11, new moon on September 19. Again in late September and early October, expect an evening moon, with first-quarter on September 27 and full moon on October 4. Last-quarter moon will be on the 11th.

Mars is the dominant evening star through August, September, and October, appearing during early evening, high and bright in the southeast among the stars of Capricornus. Jupiter is also an evening star, appearing low in the southwest at dusk and setting a few hours after dark. Venus becomes an evening star in September, but will be difficult to see. Saturn is a morning star in Taurus, rising in the late evening and remaining until dawn.

August 20: A total eclipse of the moon occurs over Asia, Africa, and Europe, but it will not be visible in North America.

August 26: Mercury, at inferior conjunction, enters the morning sky.

August 27: Venus, at superior conjunction, becomes an evening star.

August 28-29: The bright object to the right and above the moon these evenings is Jupiter. The star closer to the moon is Antares.

September 2-3: The moon is to the right of Mars on the evening of the 2nd, to the left and more distant on the evening of the 3rd.

September 4: Mercury resumes direct (eastward) motion.

September 10: Mars completes its retrograde motion, becomes stationary, and begins moving east again through Capricornus.

September 11: Saturn is below and to the right of the rising first-quarter moon in the sky this morning.

September 12: Mercury is at greatest elongation (west) in the morning sky. It may be seen as a morning star, low in the east before sunrise, for a few days before and after this date.

September 19: Saturn begins its retrograde motion in Taurus.

September 23: The sun arrives at the autumnal equinox at 11:45 a.m., EST, and autumn begins in the Northern Hemisphere.

September 24-25: The crescent moon in the evening sky returns again to the vicinity of Jupiter and Antares. Jupiter is very bright and well above the moon. Antares is much closer to the moon and is occulted on the 25th over parts of South America and South Africa.

September 30: Mars is located below the gibbous moon this evening.

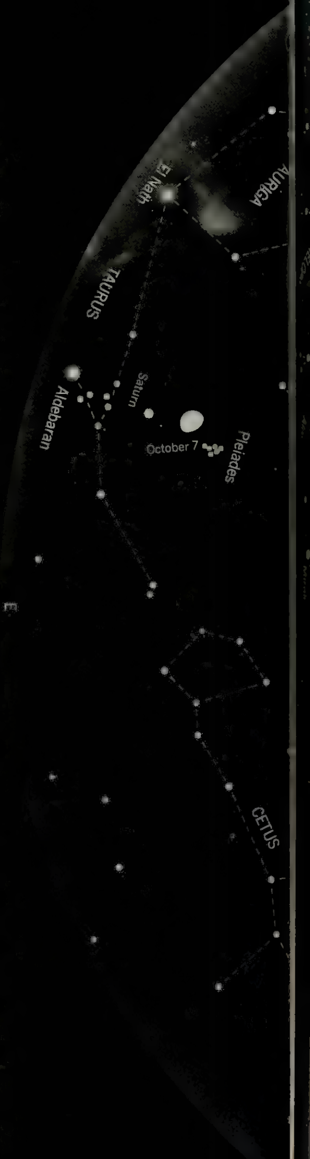
October 4: Perigee, when the moon is nearest earth, occurs within a few hours of full moon. Expect exceptionally high tides.

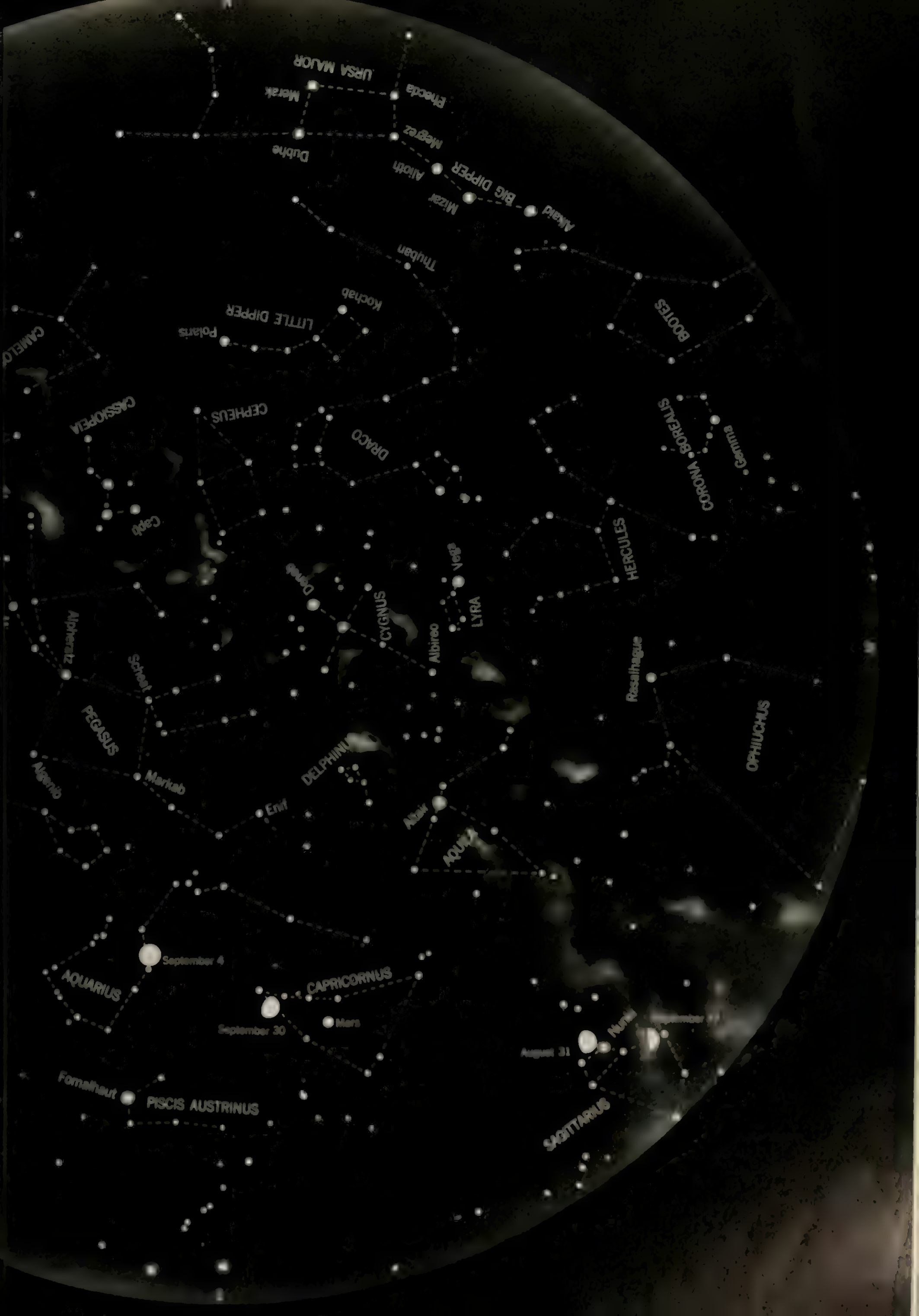
October 5: Venus is in conjunction with the star Spica. Both will be very low in the west after sundown.

October 7-8: Saturn is located well below and to the right of the waning gibbous moon tonight and tomorrow morning. Mercury is in superior conjunction and enters the evening sky.

Thomas D. Nicholson

★Hold the star map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 11:25 p.m. on August 15; 10:20 p.m. on August 31; 9:25 p.m. on September 15; 8:20 p.m. on September 30; and 7:20 p.m. on October 14; but it can be used for about an hour before and after those times.




URSA MAJOR
Merak
Phecda
Dubhe
Megrez
Alioth
Mizar
BIG DIPPER
Alkaid
Thuban
Kochab
LITTLE DIPPER
Polaris
BOOTES
CAMELO
CASSIOPEIA
CEPHEUS
DRACO
CORONA BOREALIS
Gemma
Caph
HERCULES
Deneb
Vega
CYGNUS
LYRA
Albireo
Alpheratz
Scheat
Rasalhague
PEGASUS
OPHIUCHUS
DELPHINU
Algenib
Markab
Enif
Altair
AQUI
September 4
AQUARIUS
CAPRICORNUS
Mars
September 30
Nun
September
August 31
Fomalhaut
PISCIS AUSTRINUS
SAGITTARIUS

Sensuous Symbionts of the Sea

Continued from page 37

the broth that covered the cooling earth. Lightning may have launched the final process. The progeny of that first cell have been replicating ever since to mold the living parts of the earth, in a process rather like the morphogenesis of a stupendous embryo.

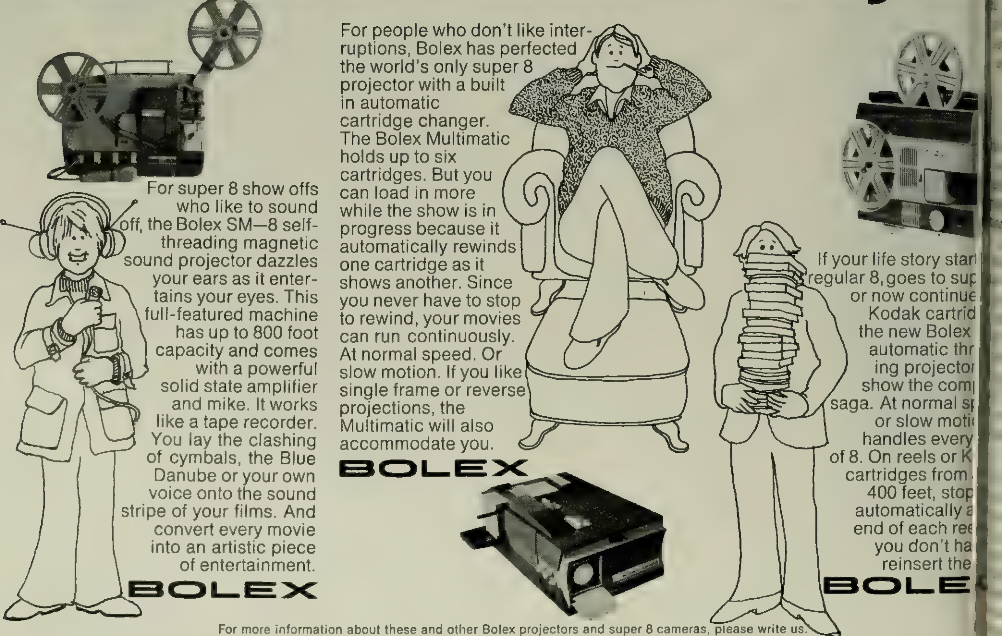
Variation and the elaboration of species have been imposed by modifications and embellishments of DNA during the long, continuous process of replication from the first strand; some of these have occurred spontaneously, some by radiation, and very likely many have been carried from one genome to another by viruses. The fusion of different sorts of primitive cells may have developed more complex types of cells. Perhaps in such a fusion the mitochondria became the main source of oxidative energy within cells; originally they were probably bacterialike cells, and they still retain their own specific DNA and RNA. The chloroplasts of plant cells, responsible for photosynthesis and hence the source of the oxygen in the earth's atmosphere, also seem to have started out as small organisms before they became incorporated as organelles in plant cells. In both cases, these essential structures can be viewed as symbionts in modern cells, and there are probably other organelles with similar origins. Our cells are no longer the pure, primary building blocks they once seemed; they are a sort of organism, and as more is learned we may realize they are ecosystems as complicated as Jamaica Bay.

The parts of cells do not seem much concerned about their individuality. In his laboratory James Danielli discovered that amoebae can be taken apart like small watches and then reassembled, using cytoplasm from one amoeba, the nucleus of another, and the membranes of a third, and the final refabricated creature swims away untroubled.

The ultimate challenge to the notion of separateness is the phenomenon of cell fusion. When cells from different animal species are placed together under the right circumstances, their membranes will join, form bridges, and fuse, and the cytoplasm will flow across to produce a single, hybrid cell—half-kangaroo, half-mouse—capable of multiplying for generations with its combined heredity intact. Perhaps it is the nature of cells to fuse, given the chance. A currently attractive theory has i that this is the way metazoan multicellular forms of life ma have been put together in the firs place, combining in the single genome of a new organism the geneti information required for assemblies of different cells with different functions.

With this kind of family histor in the background, it is not surprising that the habit of symbios remains so strong. Were it not fo the formidable arsenal of weapon and the inventive displays markers of individuality, of entit that have evolved at the same tim we might have ended up as a ma of invariant, interliving, undifferentiated life, missing all the fun.

What kind of a show off are you



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Jacques-Yves Cousteau describes his new book, an xtraordinary report on the undersea struggle for

LIFE AND DEATH IN A CORAL SEA

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LIFE AND DEATH IN A CORAL SEA, we share ore than the fantastic splendors and risks of undersea adventure. For our ship, the *Calypso*, has become a twentieth-century ah's Ark, and the conclusions I draw from er last and longest voyage are inescapable. *The seas have been poisoned*. The world of l, which spreads like some great fairyland f beauty and color over much of the earth, s dying. And so I have written this book to awaken as many people as possible to the enormity of the stakes for which man plays when he disturbs the delicate balance of life in the sea.

al *is* life. Atolls and islands *live*—as surely and fully as the brightly colored fish that lart through coral corridors. We have pho-aphed dazzling parrot fish sleeping safely ong deadly stinging tentacles; sculptured coral castles coming to life at night and battling, with a million tiny mouths, for a ace in the sea; extravagantly camouflaged oral fish performing an elaborate ballet in which the dancers face death with every uette. We have captured the beauty of the reat coral parasols and cemeteries . . . and drama of how a reef captures its food and ts it. This is a world so brilliantly colorful you may find it difficult to believe that the ectacular color displays in this book are all photographs, rather than paintings!

'Most important, we have seen during our orations what man's 'progress' has meant the animals that form and inhabit a coral It is my great hope that this record of the *lypso's* most dramatic voyage may help to rt a disaster in which man will be not only perpetrator—but o one of the most ortunate victims. ❞ J.Y. Cousteau

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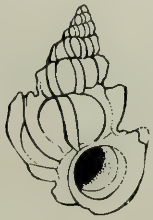

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A TIME FOR EVERY PURPOSE

Continued from page 25

divisions that indicate which ti are holy, happy, or sinful, wh are designed for work, play, celebration. These divisions are separable in our experience fi time itself, since they are tied with our rhythms and with the sations of our individual and gr experience.

Buildings and other parts of man-made environment are signed to emphasize certain asp of the past, present, or future college library emphasizes the tinuity of learning, the patient, mulative nature of scholarly w as well as the traditions of the demic community. The visito Cambridge is struck by the tho that 400 years earlier sch walked down the same halls rea books and talking aloud. A n paper office emphasizes the and now, the immediacy of the emeral present, disappearing as portrayed in banner headlines. scientific laboratory, bereft o miliar materials and forms, challenge its occupants to ima tomorrow. Sometimes the obje of a building is to take a persor of one time and enclose him ir other. An archeological mus moves a person back cent while a technology museum project him forward. The th must be prepared to create change time worlds rapidly. museum lobby should prepare visitor for the shock of mo from the rush of traffic into Pleistocene era.

There are similarities bet the objectives of local organiza dedicated to historical preserv and the ecology movement. first aims at preserving a cul ecology and demonstrating a age across time, while the points out the connection bet organisms and their environn A landscape without a sense of is devitalized and superficial. more similar to a painting, mu exhibit, or diorama than to a ral setting.

There is a real difference bet a preserved historical buildin the expert fakery of a museu hibit or Disneyland. I have n jection to the superb craftsma

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and scientific expertise involved in man-made copies of nature. Indeed I would like to see more of them, but they are not substitutes for reality. Visiting an actual log cabin in the Pacific Northwest, a man can sense the continuity between himself and the people who had actually lived there. He can appreciate what it meant to hew the timbers and fashion the nails by hand, to bring the furniture around the Horn to San Francisco, and then transport it by land up the coast. Without a time dimension, our experience of the world becomes devitalized and colorless.

Traveling across a small American city, there is a peeling back of layers of house style—from the new suburbs, to the central city, and back again on the other side. Moving to a new house is a time trip as one sorts through acquisitions and treasures, some of which have not been seen since the last move. There are high school yearbooks, old photograph albums, bundles of letters and tax receipts, impractical wedding presents never used, clothing saved in the hope that the style will return. Decisions have to be made about what is to be saved intact, what is to be altered, what is to be given away. Just as each man is his own reservoir of time, holding back immense quantities of experience, so his possessions are layers from the different periods of his life.

In the natural world, only man is conscious of time. It has an element of the inevitable and inexorable; it is connected with rhythms of day and night, lunar periods, infancy, adolescence, adulthood, old age, and death. Consciousness becomes the tool by which man works within the constraints of time and realizes his freedom and selfhood.

Just as it takes a special act of will to translate a two-dimensional photograph into a three-dimensional image, so man must learn to add a fourth dimension, time, to his conceptions of the environment. In joining with others to improve the quality of his surroundings, he must work at several time scales simultaneously—from an immediate assault on air and water pollution and the desecration of the landscape to the long-range goal of a society in harmonious relation to the earth's environment. ■

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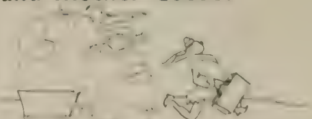

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DIGGIN

Shanidar: The First Flower People, by Ralph S. Solecki. *Alfred A. Knopf, $8.95; 320 pp., illus.*

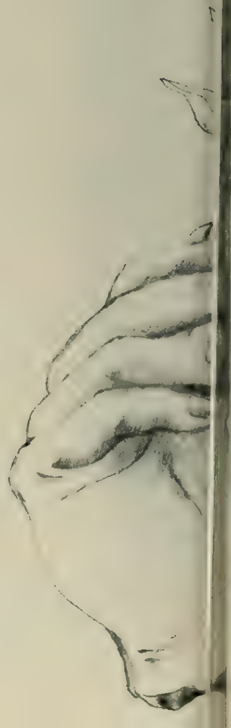
Now, twenty years after he first ventured into the Zagros Mountains of northern Iraq, Ralph Solecki has finally given us a splendid account of his activities there, his discovery of Shanidar Cave, and his excavation of the Neanderthal skeletons it contained. It is not quite what many of us assumed he was going to write, and it starts off with a quick two strikes against it before it finally settles down to tell of the fascinating adventures of four archeological field seasons in the remote and difficult country of the Iraqi Kurds.

Strike one is the title. I admit that, from Solecki's previous writings, I had been expecting his long-awaited Shanidar report to appear in the form of a dry-as-dust technical monograph. This it clearly isn't, but—*The First Flower People?* Enlivening the ponderous plod of standard scientific reporting is indeed a laudable aim, but the idea of Ralph Solecki attempting to impersonate a literary Tiny Tim absolutely boggles the mind. Let me hasten to say that he makes no such attempt. The title, then, gives one no clue to the nature of the book. The last time I was so completely misled by a title was nearly thirty years ago when I first read Roy Chapman Andrews's *On the Trail of Ancient Man.* At the time, I started reading it to find out about the discovery of ancient man—and nearly put it down from frustrated expectation before getting caught up in the sweep of a corking good adventure story. Similarly, if one expects rhetorical whimsy or romantic fantasy from *Shanidar,* one will be sadly disappointed. But persevere—it is, in fact, a corking good adventure story.

Strike two is the first chapter. If, on the one hand, this was intended to establish Solecki's intellectual command of the area in the eyes of the specialist; and on the other, to provide a broad background to introduce the general reader to the dimensions and reasons for his research, it fails on both accounts. While his gaffes in structural and historical geology do not really reduce one's confidence in his ability to control the stratigraphy of a 40-foot hole in the ground, his troubles in producing a simple explanation of the Neanderthal problem are bound to be upsetting to the scholar and confusing to the general reader. The difficulty, one suspects, emanates in part from his preferred form of verbalization. The essence of the Solecki style is, in a word, brevity. Understatement is a splendid device to heighten the drama of exciting events, and Solecki uses it with instinctive skill when he relates the narrative of his seasons in the field. The unspoken can usually be supplied by the reader's imagination.

This, however, simply does not work when the subject matter involves a century of rarefied scholarly debate. Here, issues have to be spelled out and nuances explained, and it is in this area that the laconic Solecki style becomes spastic to the point of incoherence.

The century of debate I have mentioned concerns whether or not Neanderthals are the ancestors of modern men. The preconceptions and influence of Marcellin Boule, a French paleontologist whose ideas dominated the study of human evolution for the



HANIDAR

by C. Loring Brace

first half of the twentieth century, had pretty much eliminated the view that Neanderthals could be regarded as an ancestral stage in human evolution, substituting instead the view that they represent an aberrant line that became extinct without issue. Within the last ten years, I have attempted to revive the earlier view that Neanderthals are indeed our ancestors, and despite Solecki's statement that "this classical hypothesis has been abandoned," I would maintain that it is a very live issue. In fact, in his concluding chapter Solecki himself would appear to accept my approach, even to the extent of using a slight modification in his penultimate sentence of the wording that was part of the subtitle for my article in NATURAL HISTORY, May, 1968. (I note that the article is listed in Solecki's bibliography but is not cited in the chapter notes.)

Adding further to the confusion of this first chapter is his claim that the Shanidar findings "have served to break the impasse in understanding the early man of Mt. Carmel." He is referring to discoveries made forty years ago in what was then Palestine, but he does not really tell us what the "impasse" is or how Shanidar contributes to its solution. There are other flaws in the chapter as well, but these should suffice to explain my misgivings as I approached the end of chapter one.

At that point, however, things change radically and the book launches forth on a completely different tack. My advice to the prospective reader is to peruse the first page and a half of chapter one to get a minimal idea of the reason an archeologist would go to northeast Iraq.

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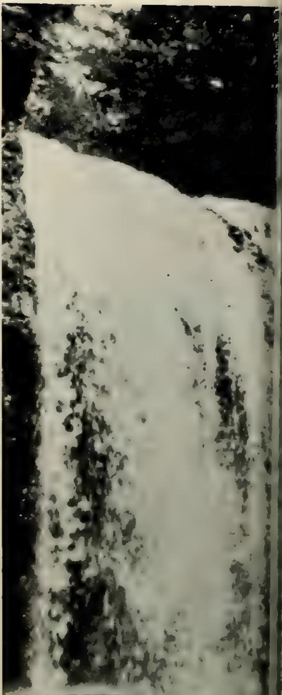
then skip directly to chapter two and proceed from there.

Even to those who neither know nor care that Shanidar Cave yielded the first remains of Neanderthal man to be dated with any precision—these also being among the most extensive of known Neanderthal collections—the story of the discovery and excavation stands in its own right as a classic of its kind. Solecki proves to be a master of that spare, flat narrative style that one associates with the cowpokes who spun their tales of the American Wild West a generation and more ago. The drama of the terrain and its people is made to order for this kind of presentation, and Solecki takes full advantage of it.

Shanidar is located close to Baradost Mountain in the Zagros chain near where the borders of Iraq, Iran, and Turkey meet. This is in the heart of the area inhabited by the Kurds, a fierce, proud, independent, and touchy group of mountain tribes whose history has been one of permanent conflict with the rest of the world, especially Turks, Arabs, and even each other. "It appears to be the environment which has made [them] so restive, independent, and strong. They maintain a scrupulously and rigidly high code of honor like knights of old, especially among themselves. Outsiders were outsiders, and this code did not necessarily apply to them. The rifle was the most prized possession a tribesman could own. The saying was that a young Kurd wished for three things: a rifle, a wife, and a donkey. And sometimes the order of the last two was disputed."

Solecki is evidently quite appreciative of Kurdish *machismo* and, as his narrative displays, more than matches it with his own. For instance, on one reconnaissance trip, just before he found Shanidar in 1951, his companion's horse tried to get away despite its hobbled front feet, and Solecki took off after it on his own. In his words, "I tried to jump from my saddle to [the other] horse in a dead run. This was a mistake, for my horse was not fast enough for the feat, and when in desperation I did try it, I fell to the ground short of the saddle, the flying hoofs of the runaway beating just inches from my head. After that, I gave up the spectacular method and ran the horse down on foot through the snowdrifts and caught him." Finis. End of episode. The next paragraph describes the dress of a group of Moslem Kurdish women.

Part and parcel of the laconic *machismo* underlying such a style is an utter lack of humor, which is often



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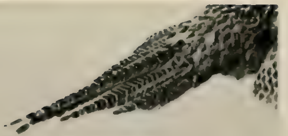
tentionally funny. For instance, s description of a lunch to which as invited by the district commis- r, Solecki notes that "our food sted of a heavy broth called *a*, which threatened to lie very y on the stomach. My host . . . that after such a meal, one had much energy, and the way to it off was to run up and down nountain as the Kurds did. I eyed broth dubiously and he laughed. the captain handed me the eye sheep with a twinkle in his own and said, 'Eat. This is an honor u.' The eye looked like an olive, here did not seem to be anything al about the taste as it went . I never understood why it was dered something extraordinary." more than one occasion, the ness seems to be overdone. For ple he describes his meeting in dad with the distinguished Brit- rcheologist Max Mallowan (who ually well known as Agatha tie's husband, although this is mentioned) and with the pre- ian V. Gordon Childe whose ap- it suicide six months later put an o a brilliant career. "After lunch Childe wanted to take a walk up id Street, the main street of Bagh- His chief objective appeared to me Edgeworth tobacco, which he rred for his pipe. We left Childe ut finding his tobacco. He re- d to the [British School of Ar- logy], a round trip of about miles, while we went on to our ers at the Y.W.C.A. We saw e again the next day. He was on ay to Australia, where he died in ver." Again, finis. End of epi- The scholar is tantalized, while eneral reader will doubtless miss pportunity for illumination that ost.

netimes one could also wish for treatment of the events that he bes in the field. Shanidar Cave arge affair as caves go—175 feet 45 feet high in the interior, and et deep, back to front. For half ear it is inhabited by half a families of Kurds, complete about 50 cattle and horses, dogs, ens, and up to 150 goats. Yet no- does he record what these e thought of a 40-foot-deep being dug in their home. To re, he does record their reluc- to be moved out of the cave he periodically set off his dyna- charges (to break up the pre- ic rockfalls encountered in ex- ng), and he does record his ise that they had done their best the pit with dung between his (1956–1957) and fourth (1960) seasons, but it never even oc-



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curred to him to ask why they chose to live there in the first place, considering the fact that they did not belong to the tribe that owned and inhabited that part of Shanidar Valley.

Despite this and occasional other displays of insensitivity, the book comes across as an enthralling adventure story. The attempt to make it academically respectable in the first chapter, along with the unconvincing effort near the end to demonstrate that one of the Neanderthal skeletons had been buried with flower garlands, are weaknesses that the reader can overlook. As an account of how a hard-nosed dirt archeologist established his niche in the history of his profession, it has no peer. I only wish that I had been asked to provide the title; I would have named it *True Grit: or Digging the Shanidar Neanderthals.*

C. Loring Brace is curator of physical anthropology at the University of Michigan's Museum of Anthropology.

More Reviews

SAVAGE LUXURY: SLAUGHTER OF THE BABY SEALS, by Brian Davies. *Taplinger Publishing Co., $6.50; 214 pp., illus.*

Among the many current evidences of the blithering idiocy and self-delusion of which man is capable are the annual spring seal-slaughtering orgies that take place in the Gulf of St. Lawrence and Alaska.

Within days after the mother seals have whelped in the Canadian gulf, men go out on the ice floes, bash in the friendly, defenseless animals' heads with clubs, and skin them on the spot for pelts prized in the garment trade. The same thing goes on under United States auspices in the Pribilof Islands, only here it involves grown seals, corralled along the shore.

The spectacle perennially appalls not only witnesses from humane organizations but also newsmen who have watched the slaughter and millions of private citizens in both North America and Europe who have seen the activities in still and motion pictu

Thanks to conservation organi tions, the use of wild animal pelts clothing (in the tradition of the c man) has become increasingly fashionable in the last few years. the seal hunts go on, under blatantly spurious rationalizatio One is that seal hunting is a v source of income to a sizable num of seal hunters. The other is hoary exploitationist argument "reduction of the herd" is necess for ecological balance.

For seven years Brian Davies, or nally executive secretary of the Brunswick (Canada) S.P.C.A., led a widening crusade against barbarism. His book is a loose-joi narrative of the vicissitudes of campaign, from eyewitness acco of the St. Lawrence seal slaughter reports of his bouts with Canadian ficials afflicted with all the my stuffiness of Victorian "Em-p statesmen rationalizing the rout Balaclava as a triumph. Davies Welshman, at one point was h before a parliamentary investiga commission and practically acc of being subversive. But through campaigning he has chipped awa the once virtually uncontrolled hunt, achieving some diminutio its cruelty, reduction of the slaug quota toward a 1971 level of 50 animals, and annual observatio news media that points toward gory shambles eventually scorned out of existence. The sade's dimensions eventually be too much for the New Bruns S.P.C.A. and it has moved unde aegis of the International Fund Animal Welfare, of which Davi the executive director.

Davies is a better campaigner he is a writer. Amid occas flashes of telling imagery ("Ste almost with a concerted rhythm clubs rose and fell"), he lapses often into toe-crinkling trivia (" one to fret about the unattaina contentedly read books and m zines during the long flight"). his delineation and structuring o over-all problem seems tentative rambling when it should be in and decisive. He touches on the nomic sophistry of the seal hunt doesn't seem to realize that—as the supersonic transport—this i key weakness by which it ca blown out of the water.

The Canadian government, o basis of sheer arithmetic, impe itself in claiming economic va for the St. Lawrence hunt. It ha tended that the hunt is vital t livelihood of 6,000 hunters. The lasts only one month a year, an

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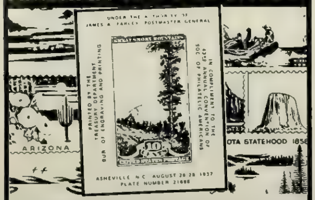

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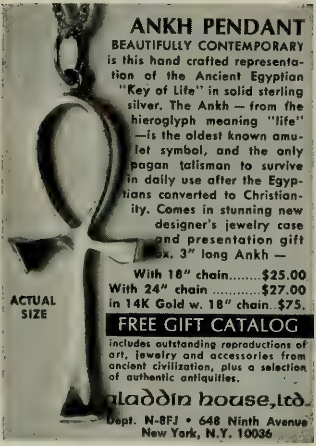

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ently no ordinary person makes a year's living in one month. Fifty thousand seals divided by 6,000 hunters is only eight seals per hunter, and patently nobody is going to make a year's living wholesaling the pelts of eight small animals. The same nonsense is espoused by the United States government with regard to the few hundred Aleuts involved in the Pribilof hunt. With the government paying out billions of dollars a year even to wealthy farmers not to grow crops, some more civilized way of sustaining the Aleuts obviously could be devised.

Davies doesn't hit these arguments hard enough. Nor does he light hard enough into the "herd reduction" myth. There are millions of years of history to attest to the ability of species—from bugs to trees—to survive without gratuitous man-imposed population controls.

Despite its flaws, however, *Savage Luxury* is a good introduction to the subject for the increasing millions of people concerned about this outrage; and a salutary rebuttal to offerings like *The Year of the Seal*, by Victor Scheffer, the ex-federal biologist who deals in "herd reduction" and such bureaucratic twaddle as: "Humaneness is indefinable." Thanks to people like Davies and his citizen supporters, a definition *is* emerging.

GLADWIN HILL
The New York Times

RACE AND RACES, by Richard A. Goldsby. *The Macmillan Company, $5.95; 132 pp., illus.*

Not too long ago, political mania, mass psychology, and national self-hypnosis revived the *Herrenvolk*, or "master race," hypothesis that eventuated in a global holocaust and an attempt to eradicate certain religious groups. Today, in such places as South Africa, so-called democratically elected governments legalize, through their statutes and constitutions, racial "superiority" of whites and maintain social degradation of blacks. Educational systems, national attitudes, religious teaching, political democratization, historical perspectives, and mass media have failed somewhere along the line—not completely, but sufficiently to keep racism fanning the flames of hatred, bias, prejudice, and inequities in Asia, the Middle East, Europe, America—virtually throughout the world. It is well recognized that culture is transmitted rapidly while biological evolution is a slow process. "Civilization," however, has lagged far behind bio-

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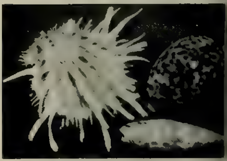

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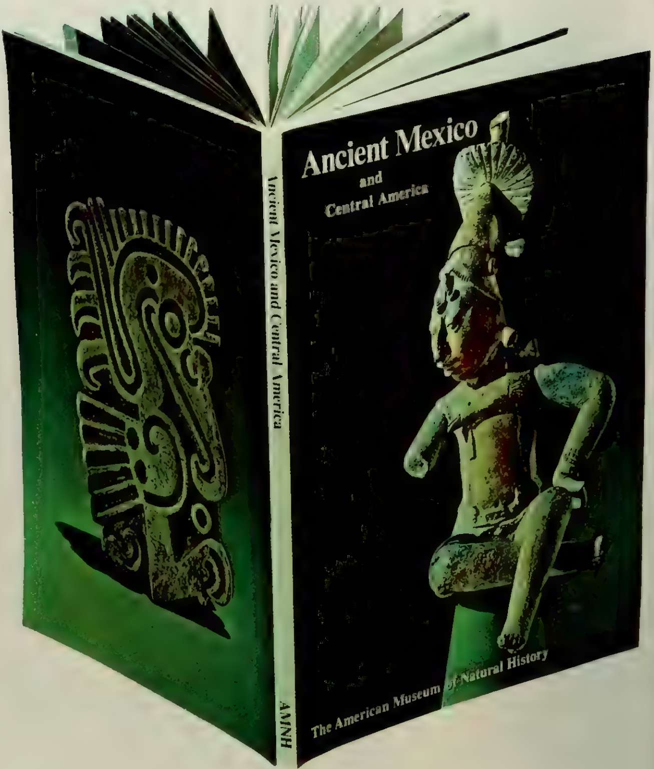
. . . as clear and concise an introduction to Meso-American archeology as you are likely to find anywhere. Lee Boltin's photographs are (as usual) first rate . . . Applause.

—John Canaday*
The New York Times



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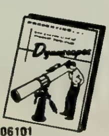

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logical adaptation, which has established man as a unique morphological animal.

It is almost a common principle of recent life that politicians, lay people, and the like abuse and misuse the creations of scientists, and then, when things go awry, blame the scientists for the havoc resulting from such misuse. Races are reasonable subdivisions, or units, for pigeonholing vast, widely distributed populations. In their search for an understanding of the common factors establishing likenesses and differences among people (and other animals, plants, and insects), scientists have established reasoned criteria—morphological, chemical, behavioral—for identifying racial differences and similarities. Scientists have "developed" races, but other people have conceived racism.

Consequently, although there are many, many books dealing with race and races, and although organizations such as UNESCO have carefully discussed and arrived at acceptable definitions of race, it is always heartening to find new books being published that bear testimony to the objective research dealing with human variation and adaptation. *Race and Races* is a simple review of aspects of human biology related to race. Too often it is oversimplified, which must leave the innocent reader with the feeling of an open and shut case, as if most of the answers are in. It would seem that there are not too many interesting problems left to tackle. For example, according to the author, the relationship between sickle cell anemia, thalassemia, and malaria seems to be solved, but this is far from being the case.

Another example of over-simplification, and one which may lead to misunderstanding and eventual misuse, is his contention that "the negro body type . . . represents a body build adapted to lose heat" and that this type is found with high frequency in black populations. There are numerous exceptions to this rule: for example, the tropical Pygmies, the Watusi, and the Andaman Islanders, and this body type ("relatively short body and long limbs") is fairly well represented in populations where the adaptation is not a survival factor, as the author implies. Goldsby, who does not pretend to be a recognized scholar in human genetics, quite clearly admits that the book is "intended to be an introductory survey of the contributions, both factual and conceptual, various areas of biology have made to the study of race in man." The style is easy, and the text flows and reads well. Although the

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hor has tried to avoid technical
gon, this is not always possible;
re explanatory footnotes seem to be
uired even for the well-informed lay
der.

No classification of the races of
nkind will suit or be agreed upon
everyone. It is not even important
ether one divides populations into
or into thirty-six subgroups, as
g as the criteria for such delinea-
are reasonable and consistently
ered to. The seven chapters deal
npily with the origin, concepts,
definition of race and races, hu-
variability, and genetic traits.
re is a rather naïve description of
evolution of man, as well as a dis-
sion of the possibility of racial
ation of mental ability. One can
issue with many statements, both
act and inference, throughout the
k (for example, what is a "more
erful brain"?). But these are usu-
minor and do not detract from
over-all usefulness and clarity of
presentation. I criticize the choice
hotographs of "typical" types—
n mob scenes. The photographs
be pretty, travelog-type portray-
but many do not enhance or sup-
nent the text descriptions.

he only distasteful aspect of the
is, I presume, not of the au-
's making, but the publisher's.
paper jacket displays *Race and*
s, but after the "and" one finds,
rackets, "a black biologist writes
it actual racial differences and
significance." Now it is obvious
this is a sales gimmick because
author's text is certainly not in-
ced by his skin color. The blurb
only be viewed as racist sales
the kind of approach the author
emns in his first and last chap-
Furthermore, there is another
liar statement on the inside flap
e jacket: "Here, *for the first time*
ewer's italics], scientifically cor-
information . . . is made acces-
to the general reader." No new
appear in this book; it is a well-
en reshuffle of previously pub-
d views and evidence. The state-
is untrue. I can think of half a
n other books with similar data,
written by black biologists and
able to the general reader. The
would sell even without such
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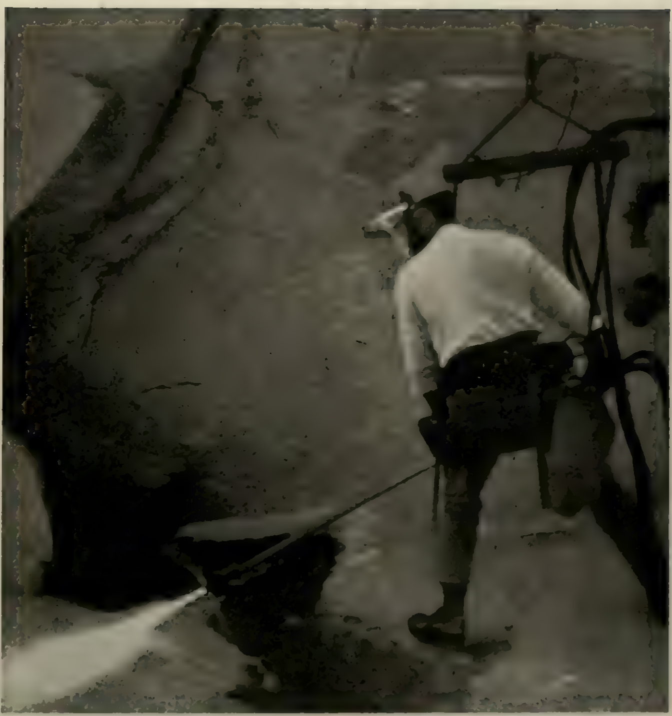

Another of those "impossible" views with a Questar

At historic Stone Mountain near Atlanta, a carver works on the Confederate Memorial. (See covering shot below taken with 50mm. camera lens, showing Questar Field Model mounted on Linhof tripod, Topcon camera attached, and worker indicated by black arrow.) The Questar photo, above, on Tri-X, 1/60 second, shows him in constant motion as he swings from a harness on the sheer granite wall, guiding himself with his feet and vibrating with the thrust of his powerful thermo jet torch. The photoengraving process permitting, you will notice such detail as his belt loops and a band around his left ankle. Photographs by Mr. and Mrs. Ralph Davis of Sarasota.

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ulation control, a change of pace is in the offing. They may now sing about it. *Survival Songbook* presents music (for guitar) and lyrics to some 59 songs on how to save this planet. Some are bitter, some are poignant, some very funny. Others just offer antipollution advice: "Don't use a tissue, sniff instead; Don't use a napkin, use a piece of bread." Among the many contributors are Pete Seeger, Malvina Reynolds, and Tom Lehrer, and all are "using the only tools they have to turn people's heads around."

C.B.

GALAPAGOS ISLANDS, by Alfred M. Bailey. *Denver Museum of Natural History, Museum Pictorial No. 19, $1.50; 86 pp., illus.*

Since Charles Darwin, in his *Voyage of the Beagle*, told of the amazing fauna and flora of the Galápagos Islands, these remote isles have been a mecca for naturalists. Only recently have organized tours brought them within reach of the individual not fortunate enough to possess a private oceangoing yacht.

Alfred M. Bailey, superb photographer and retired director of the Denver Museum of Natural History, led a recent expedition to the Galápagos. This profusely illustrated booklet will serve as a convenient introduction to this fascinating subject. Luckier still are those who see Dr. Bailey's film of the tortoises, marine iguanas, tree cacti, and other wonders of the "Islas Encantadas."

D.A.

AN OMISSION

Owing to a mechanical error in the May issue, Howard T. Odum's name was inadvertently dropped from the article "A Print-out of the Future Systems of Man." The article was adapted from the final chapter of Dr. Odum's book, *Environment, Power and Society.*

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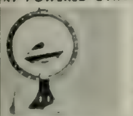

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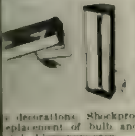

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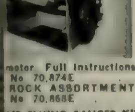

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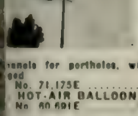

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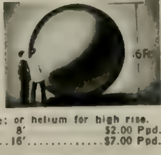

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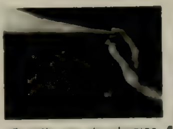

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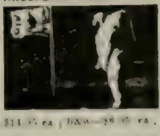

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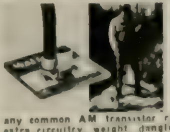

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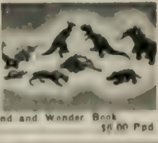

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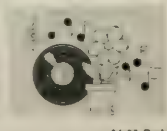

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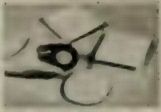

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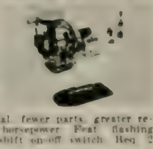

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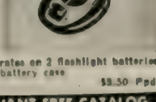

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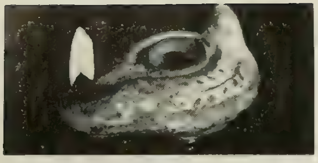

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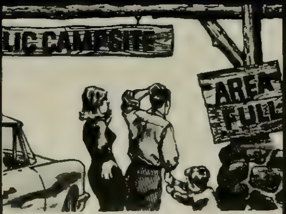

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DJUKA: THE BUSH NEGROES OF DUTCH GUIANA. M. Kahn. The Viking Press, Inc., New York, 1931.

MAGIC, FAITH AND HEALING. A. Kiev, M.D. The Free Press, New York, 1964.

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MARINE ANIMALS. R. V. Gotto. American Elsevier Publishing Co., Inc., New York, 1969.

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MEN AND APES. R. Morris and Morris. McGraw-Hill Book C pany, New York, 1966.

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A GUIDE TO ARTIFACTS OF COLON AMERICA. I. N. Hume. Alfred Knopf, Inc., New York, 1970

HISTORY OF THE AMERICAN WH FISHERY. Vol. 1. A. Starbuck. gosy-Antiquarian, Ltd., New Y 1878.

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ICELAND AND MID-OCEAN RIDGES. Björnsson, ed. Societas Scientia Islandica. Prentsmidjan Leiftur F., Reykjavik, 1967.

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THE FLOWERING PROCESS. F. B. isbury. Pergamon Press, Elmsford, 1963.

THE BIOLOGICAL CLOCK. F. Brown Hastings, and J. Palmer. Academ Press, Inc., New York, 1970.

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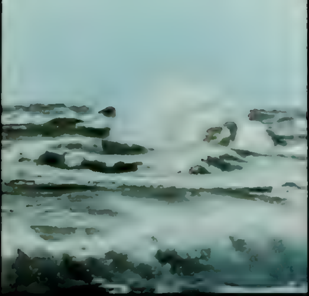

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NATURAL HISTORY

INCORPORATING NATURE MAGAZINE

The Journal of The American Museum of Natural History

Gardner D. Stout, President   Thomas D. Nicholson, Director

Vol. LXXX, No. 8   October 1971

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Authors

According to **Ira J. Winn**, who has long had a critical opinion of the Los Angeles way of life, the view into the Los Angeles Basin is not what it used to be, and the smog that obscures mountains now holds the potential for a major air pollution disaster. Winn, who obtained his Ed.D. from the University of California at Los Angeles, is an associate professor of education at San Fernando Valley State College, where his specialty is teaching environmental education. He has served as an adviser to the Brazilian government and is currently at work on a book about the ecological crisis.

Mysterious footprints, the fascinated stare of a doctor of anatomy, and a foreboding mirror—these episodes in the life of author **Loren Eiseley** are related in "Creature from the Marsh," a personal insight into the link between man's past and future. This excerpt is
from his latest book, *The Night Co*
try, scheduled for fall publication
Scribner's. Benjamin Franklin Pro
sor of Anthropology and the History
Science at the University of Pennsyl
nia, Eiseley's last article for NATU
HISTORY MAGAZINE, "The S
Dragon," appeared in the June-J
1970, issue.

To study all seventeen species
storks "at the nest," **M. Philip K**
has ranged from Florida to India, (
lon, Southeast Asia, Japan, Poland,
gentina, and East Africa. His goal
been to understand the complex bel
ior and stunning courtship display
the storks. For his next research p
ect, a study of the ethology and eco
of all flamingo species, Kahl, who h
a Ph.D., in zoology from the Unive
of Georgia, plans to circle the glo

Raymond C. Murray was abl
pursue a long-term research intere
evaporite minerals and dolomite du
his recent field studies on the islan
Bonaire, Netherlands Antilles. The
velopment of a major saltworks du
his stay led him to a study of
and its history. Other field work
taken him to Newfoundland, wes
Canada, the western United St
Holland, and the Persian Gulf, bu
next project will be closer to hon
study of sedimentation in Sandy H
Bay, New Jersey, and its effects
shellfish. Murray is chairman of the
partment of Geology at Rutgers Un
sity and coauthor of an upcoming b
Origin of Sedimentary Rock, to be
lished by Prentice-Hall. His Ph.D

ogy is from the University of Wis-
sin.

city boy from Brooklyn, New
k, **Alan M. Beck** combined his first
l trip with his honeymoon. It
ked well, and with the aid of his
, Carol, who became an expert skin-
of mammals, he was able to learn
h about the effects of fire on the ro-
t and deer populations of the prairie
and Crex Meadow, Wisconsin. His
sent research on the stray dogs that
n the streets of Baltimore is part of
doctoral program at Johns Hopkins
versity's School of Hygiene and
lic Health. Beck believes "you can
n a great deal of ecology from dogs,

ch is why I am encouraging others
ppreciate the city as an exciting and
le ecosystem, worthy of study and
servation." Beck obtained an M.A.
oology from California State College
os Angeles.

Continued on page 4

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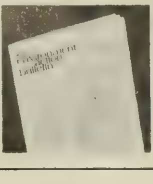

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Because aboriginal life is di appearing from the South Pacific, K Muller is now back in the New He

rides, making films and gathering e nographic materials with a heightei sense of urgency. Muller, a free-lai photographer, studied at the Film St Center at Harvard University and ma several trips to the New Hebrides anthropological assignments. He born in Budapest, Hungary, and has M.A. in French literature from the U versity of Arizona.

Since late 1968, Susan Schlee been ensconced in the library of Marine Biological Laboratory at Wo Hole, working on a history of oce ography. As one result of her resear

she has uncovered many interest sidelights of oceanic lore. Schlee graduate of Vassar College, wrote " the Fat and Sullage Fuddy Murrinei for the December, 1970, issue of NA RAL HISTORY MAGAZINE.

Is there yet a place
where the land is unspoiled
the animals have no reason to fear man
and mother nature can still keep her balance?

arig presents the Botswana Safari to Africa.

re is such a place and it all ts when you board your Varig nes jet for Rio de Janeiro. A days in that exciting city and on to our adventurous safari frica and Botswana.

our BOTSWANA SAFARI only nine sons per departure—accomied by an experienced host— explore this land, truly one of planet's last remaining regions nspoiled nature.

swana (formerly the Bechuana- d Protectorate) resembles ningway's Africa of decades and the very cadence of the nes of the places you'll see tell what may be the most un- gettable 20 days of your life. un and Lake Ngami. Tsodilo s and Shakawe. Okavango, vai River, Moremi Game Re- ve. The Savuti Marshes, Chobe ional Park and Victoria Falls. I'll see few humans other than ssibly bushmen whose an- tors have lived there for half a ion years.

But you will see and photograph wildlife. Perhaps a lone lion en route to a watering place. Herds of buffalo, wildebeeste, zebra and impala. Birdlife abounds with waders and weavers, herons and egrets, huge flocks of stork and flamingo by the thousands.

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“Down with stereotyped hotels

Local delicacies grace the menus of each Esso hotel. Some are mysteries. We also have menus for children.

Esso Motor Hotels Inc. started business in 1963. It is one of Jersey’s fastest-growing European affiliates.

The company now operates fifty hotels in nine different European countries. Last year, they provided bed and board for over a million guests. With twenty-six new hotels on the drawing boards, they expect to triple this figure by 1975. Some business.

We hope this advertisement will give you an idea of what caused this success in eight short years. Esso’s frontal attack on modern hotel monotony is probably at the heart of it.

Esso hotels are not the familiar shoe-box stereotypes. They are full-fledged hotels specifically designed to offer shelter, recreation and blessed variety to the motorist.

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And so it goes in six other
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are chosen for their genius at
ing local dishes as well as for
skill at running a good internat
kitchen. All managers speak se
languages. And the wine lists
delight.

We think the best testim
to the food and ambiance c
from the locals themselves. A
70 per cent of the guests at an
hotel come from the count
which it sits. Can we say more

For information and re
tions, write to the U.S. Rep
tative of Esso Motor Hotels, R
F. Warner Inc., 630 Fifth A
New York, N.Y. 10020—or
phone (212) 586-4500.

Here is the English manor house within the grounds of an Esso hotel at Maidenhead, England. Within a few hundred yards, you can walk four centuries.

ys Esso in Europe.

.sso hotel in Hannover, Germany, game park. The deer are friendly. ild boar are not.

Our hotel on Sweden's Lake Vattern has a marriage chapel, just in case you fall hopelessly in love.

Your welcome comes in several languages. One is universal. Service. Esso employees smile because they like people. And they like their jobs.

We can care for your car during your stay. Spot trouble before it happens. The thought should help you sleep.

**Standard Oil Company
(New Jersey)**

Esso

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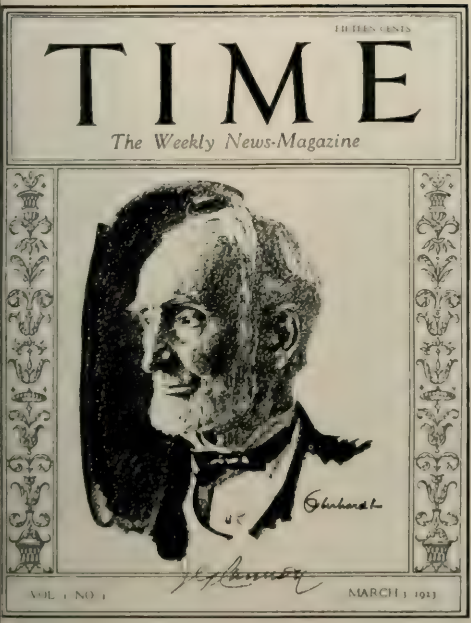
March, 1923



September, 1970

TIME
Star for an Uptight Age
Elliott Gould

Still fancy free...

hen we started in 1923, we believed building our new magazine on fact t fancy. And staying free of fancy ant a lot of old-fashioned legwork, e checking and double-checking d digging for details. And, of course, s still the same today.

But what makes TIME more than t a weekly collection of news is ability to analyze what has ppened . . . and why. Not one-led opinion, not quick judgements, but clear assessments growing from gathered facts, figures and conflicting points of view. And it's not easy.

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Letters

Hellfire

Thank you very much for your most interesting article "Hellfire" which I just finished reading in NATURAL HISTORY.

Since I was brought up a Catholic without my permission, even before conception I began to be brainwashed with *Liber miraculorum.* Ah! How they use Latin language to fool the people.

In 1918 my mother advised me to go and have confession with the other boys from the village, prior to going for our military visit for the induction into the Austrian army. The young monk who performed the confession asked me: "Are you ready to fight for our Apostolic Royal House of Hapsburg?" I was so stunned that I did not for a moment know what to reply. But I managed to shout at him "Go to Hell"—Go to Hekla.

JOSEPH SPLIVALO
San Francisco, California

Sound to Prostrate the Heart

Thank you for the wolf record. Listening to it I felt vague stirrings as of ancestral memories—then I knew! It was the sound of the shofar—the ram's horn sounds which are meant to "prostrate the heart" and draw the listener closer to his Maker. I saw the lonely shepherd guarding his flocks at night surrounded by the howling wolf packs—truly a sound to "prostrate the heart."

I wonder what a rabbi would say if he heard your record.

BALBINA TAVIN
Brooklyn, New York

The New Prophecy Revealed and Reviled

Howard Odum's "Print-out" made fascinating reading until the apparent *non sequitur* regarding the "incorporation of the energy ethic into religious programs." A wandering of a computer's mind, I thought, until a statement regarding "some stability of institutional unification . . . for world organization" served to remove some of the puzzlement, yet not entirely.

When it was laid on the line with this pronouncement, "the codification of yet unfounded religious faiths" and the emergence of "new prophets . . . for religious adaptations to the complex modern system," then I was convinced that Howard Odum was yet another of the "spiritually humble little people" so rapt in his endeavors in the Puerto Rican rain forest as to be unaware of the advent of just such a One as to be the answer to his query, "Prophet, where art thou?"

A hundred years ago, the Prophet of a New Era voiced such sentiments as Professor Odum implores. This Prophet's plan for man is exactly such a "religious system . . . to hold individuals in support of World Order," and in the way Professor Odum suggests, "that dedicate people to group causes ultimately favorable to themselves."

Baha'u'llah, whose name means "The Glory of God," founded the Baha'i Faith, which holds, as one of its most urgent tenets, the complete accord of science and religion. It holds that religion must always be aware and ready to shift its position in the light of new scientific discoveries. It (the Faith) has not only taken "the best ethics of the old to include the new," but has built itself solidly upon the firm foundation of all the great revealed religions.

The intricate details of a new World Order have been painstakingly contrived by Baha 'u'llah and unknowingly and unwittingly followed in many of its aspects by the civilized world. There are already, on a global scale, the "millions of men who have faith in the new networks and endeavor zealously for them!"

Prophet, where art thou? Indeed!

ABE TOBIS
Grass Valley, California

The Author Replies:

One point in *Environment, Power, and Society* is that in times of rapid change, new truth must be continuously revealed by the system (God) to its individuals. Most of the formal religions instead, are built on a past period of revealed truth and don't have a mechanism to accept amendments.

I looked into Baha'i several years ago in Puerto Rico, and was advised that was not really different in that respe at least as now practiced, since teachers draw authority from p prophets' writings instead of from changing world. For example, it has tenets on alcohol, sex, etc.

Revelation is all about us now but religious truth cannot be seen by th who draw their basis for truth fr documents when God was younger. give special place to a past prophet is deny an open heart to God. This is w many scientists are deeply religious cannot accept any formal church.

Lo

HOWARD T. OD
Research Profes
University of Flor

It was first with hope and then w trepidation that I read the article Print-out of the Future Systems Man" in your May issue.

The use of the *deus ex machina* religious power to supply the so power to force the world into one g ernment, or at least one effective g ernment, is reprehensible. Religi movements are not ethically p dictable, and a given religion has control over ethics than the culture the adherents. Witness Christianity Scandinavia versus Italy, or the sades, or the Inquisition, or the ot aberrations of various religions thro the ages.

A system that requires the huma change his spots is an inherently stable system; the advocate of suc system is either dealing with a non tem or nonhumans. The "relig switching system . . . capable of n ing . . ." is nothing more nor less t thought control. Thank you, bu given the choice, I would prefer to as a man, with my mind my own, ra than exist as an ant, even with bui switching systems.

That final line, "Prophet, where thou?" expresses all that is bad al the philosophy and practicality of article. Are we savages, crying in darkness for the ghosts of our fathers to drive out the demon in us will we use our intelligence, create nal systems which thrive on our indi- ual drives, on our humanity, which ow us to be people, and not carefully lt ants?

GARY L. ANDERSON
Oxnard, California

Tweedledee and Tweedledum

The article "Hassles in the Park," by k Hope, was very disappointing. w can anyone accept his picture of rk Ranger as Bad Guy, much less ders of NATURAL HISTORY?

Here are two points that made me red:

1. Hope maintains that "loud and wy" motorcycles are no more than odest takeoffs" on the family sedan. is is nonsense; one could as easily be- e that a chain saw is a "modest off" on a bumblebee.

On my last outing on a trail half a e above the valley, the most annoy- things were the sounds of the mo- cycles and the stench of the diesel es. Haze due to the family sedan is a tant third as an assault on the senses.

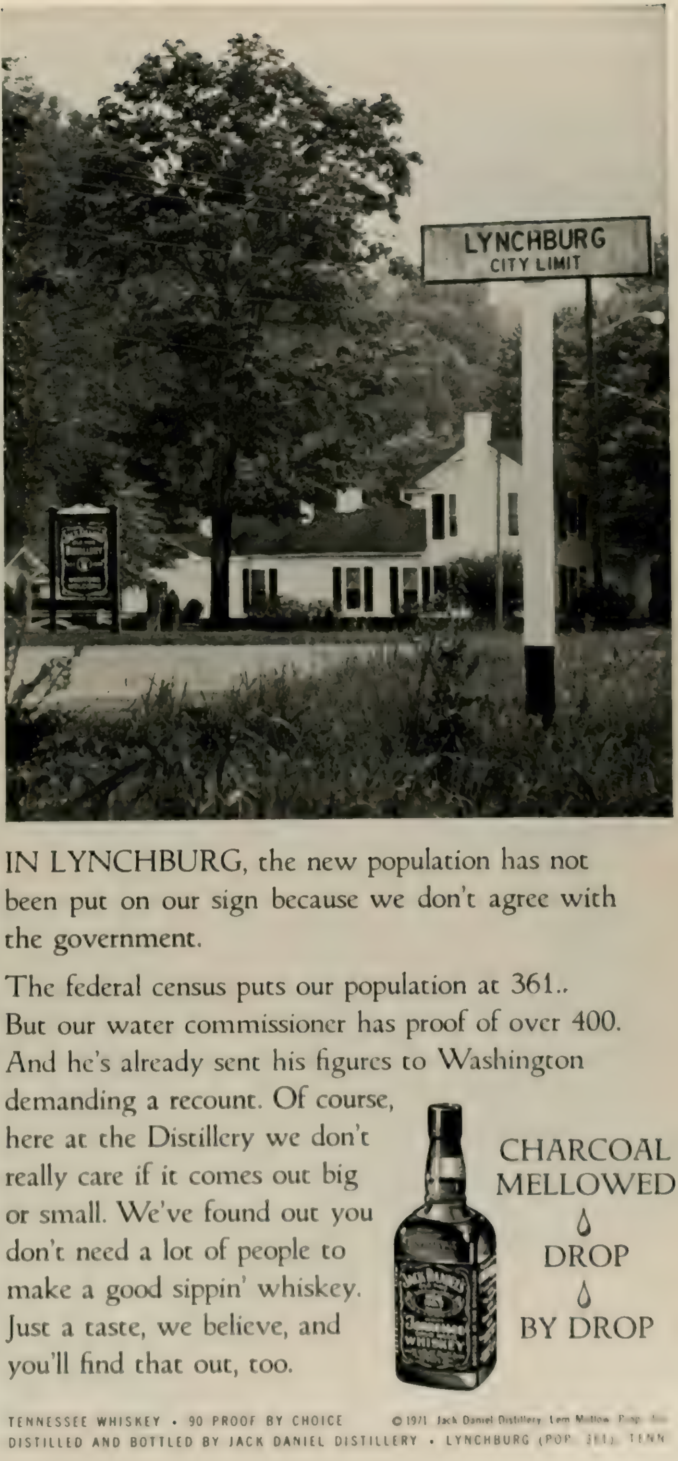
2. Hope says that enforcing regu- ons against loud mufflers, pets off sh, and hitchhiking are discrim- tory.

The first two are obviously in order. w can one photograph a doe that is rtled by a motorcycle and chased ay by a boor's dog? I can't say about third one, but I will take the gers' word for it.

This article made me realize how d I am of hearing Tweedledee come ring by on his motorcycle, smoke , and trample the meadows in gangs, l then complain about Tweedledum, h his mobile home, TV, and booze. a nonsmoker (pot or tobacco), non- nker, who drives a quiet car and kes nothing but pictures, leaves thing but footprints," I say a plague both your houses!

We'll solve Yosemite's problems en we ban all vehicles but nondiesel ttle buses, close half the facilities, l intercept all Polaroid camera own- and hang trash bags around their ks!

JEROME PEARSON
San Jose, California



IN LYNCHBURG, the new population has not been put on our sign because we don't agree with the government.

The federal census puts our population at 361.. But our water commissioner has proof of over 400. And he's already sent his figures to Washington demanding a recount. Of course, here at the Distillery we don't really care if it comes out big or small. We've found out you don't need a lot of people to make a good sippin' whiskey. Just a taste, we believe, and you'll find that out, too.

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BY DROP

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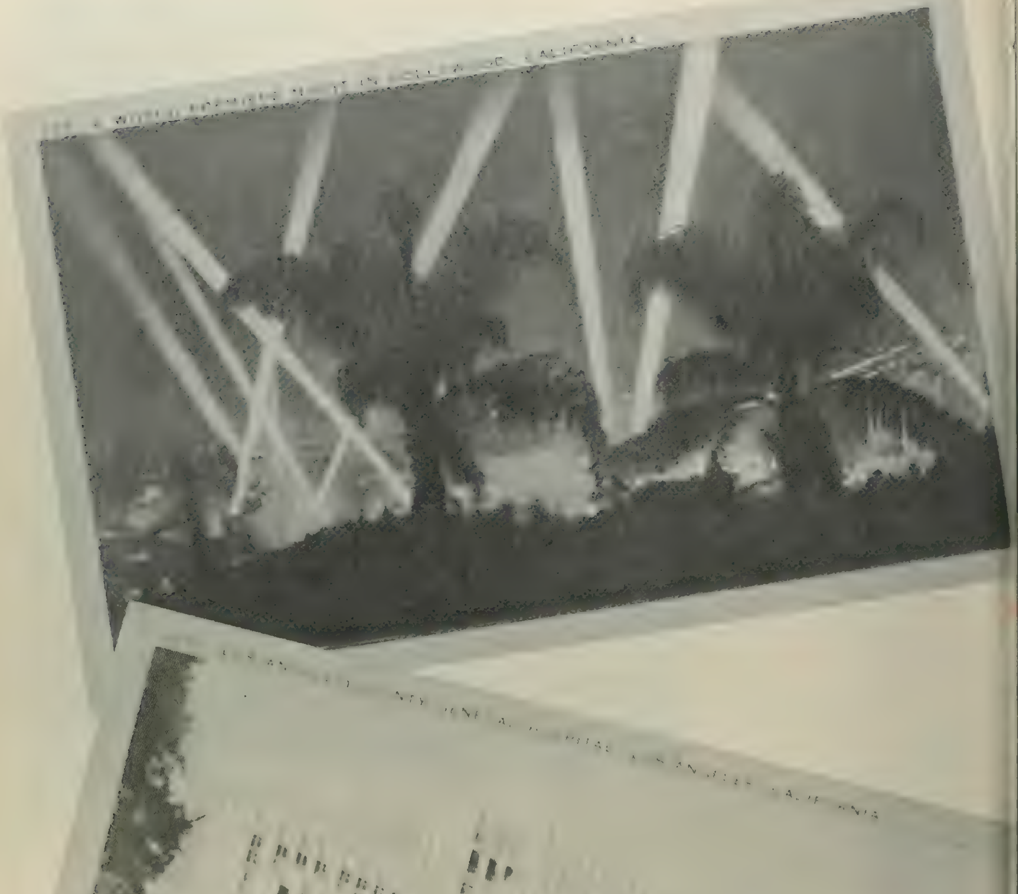
LOS ANGELES COUNTY GENERAL HOSPITAL, LOS ANGELES, CALIFORNIA

Greetings from
LOS ANGELES
CALIFORNIA

ution: Do not run, skip, or jump on pollution alert days

Ira J. Winn

Sometimes, after an especially heavy
fall and if the life-giving westerly
ds are blowing strong from the sea,
blanket of smog dissolves and dis-
ates and visibility increases fantas-
lly. And if then the roiling cloud
ks lift off the peaks to the north and
t, one can see the entire Los Angeles
sin in a rare state unveiled and
tlingly beautiful. In the colder
nths an occasional mantle of snow
y add to the brilliance of the back-
und. The powerful contrast is
ghtened even more when one views
scene framed between palm fronds
the sprawling megalopolis below.

The great San Gabriel crests rise up
nine, ten, and eleven thousand feet.
rmally, however, they appear
unken or are obscured by a natural
e as well as by the gray-white or yel-
-brown vapor that has become
onymous with the city of the freeways.
t after the cleansing rain, like ghost
ps seemingly borne by the wind, which
ear from nowhere and hover as a
ening hand, the peaks loom gigantic
a few hours, perhaps even a day or two,
talizing and strangely threatening in
eastern sky. At such times, people can
seen stopping their cars for a better
k or peering from behind curtained windows; even standing on street corners and exclaiming in feigned innocence or true awe, "God, how close they are! I always forget that you can see the mountains from here."

Soon the gray, arching crests are gone. Slowly they fade and seem to grow smaller. By noon they are all but forgotten. At most dim shadows on a bleak horizon, they blend and are lost along with everything else in the stinging sea of haze that is a mark of man's war with nature and a city's shame.

It was known as the City of the Angels. But the orchards have all but disappeared and the land of milk and honey has given way to other things. Now, in an endless "sluburbia" patched with wilted forest and faded orange blossoms, the car has become God, and gasoline the breath of life. Surely, the path to heaven from Los Angeles must be made of concrete, twelve lanes wide. Angelénos are unanimous in wishing the smog would just go away, but as yet they are little inclined to do anything that might make that happen. On the worst pollution alert days, most people gripe between coughs but one quickly learns that it is bad manners to get too angry about what flows into one's lungs.

Still, go and ask how the smog is in any area of comfortable and better homes. Visit on a day fairly thick with stench, when the horizon is a biting gray-white or yellow, and the basin, from 5,000 feet, looks aglow with corrosion. Ask in Pasadena or Glendale or Hollywood or, if you have the courage, in posh Beverly Hills and Westwood. "Smog?" The chances are they will parry the question with a half-incredulous air. "No, not bad in this area . . . a few days out of the year perhaps, but the air is pretty clean here. Now, *there* is smog," pointing to the glary horizon. "But out here," pointing straight up and looking down, "we have a wind that backs it off." Or, "This street is up a little. We are over it all, you know." Or, "That hill acts as a baffle so the smog can't get in." "Sort of a venturi effect on this block." And so it goes. Despite what the nose cannot deny, each neighbor is ready to swear that the air is always cleaner in his own backyard. "But it sure is bad—out there!"

In part there is some optical basis for this curious phenomenon of denying an unpleasant truth. Looking straight up, and thus through the pollution belt to the sunlit space above it, the sky appears relatively clear and blue on bright days. But looking almost horizontally, and thus cutting at an angle deep into the haze layer—rather than up and beyond it—the horizon appears grayish white or even yellow. The person seeking confirmation of the existence of a personal oasis of clean air finds what he

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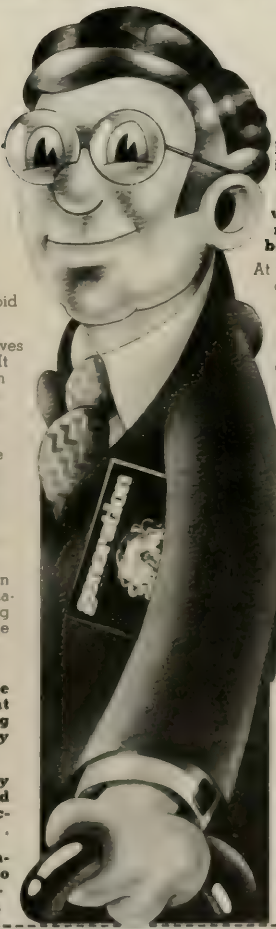
N.H.

is looking for. But what he fails to understand is that nearly everyone else is also seeing blue sky over his own home, and probably feeling sorry for people who live "out there." This atmospheric condition regularly develops in all but the most afflicted areas of the central and east basin. There the blanket of filthy air is almost continually so dense that it is impossible to deny—even if the sun does sometimes manage to break through in the late afternoon.

Of course, how smog is perceived is relative. What is interpreted as clean air by one person may be an acute irritant to someone else. Some people are unconscious of the smells and haze, except on the worst days, while others sense almost immediately the slightest rise in air pollution. In time, most people come to accept the general sm level in their own neighborhood "normal." They rationalize by pointi to other areas that are worse off th they are. But as the basin has filled with people and cars, these differen matter less. What yesterday was cal "heavy haze downtown" is today beled "clear sky" in the sprawling s urbs. Thus, individual perceptions but vague and tricky indicators o more fundamental malady that is uncomfortable for most people to c template.

Economic considerations alw come first in this world's largest mar area for the automobile. Anything t might restrict the car market or sl highway expansion is seen as a threa the profit column and the comforts

If You are a Young Executive We Invite You to Accept a Copy of Generation–FREE



neration is a monthly magazine edited for ung executives. That's why we think you l be interested in seeing a copy free, and subscribing after you see it, at a $3.01 ings!

siness is changing dramatically—new technogies, new methods, new opportunities—d you, the young executive, are in the right ce at the right time to take advantage of it. at is, if you know what the changes are and avoid mistakes other young businessmen have made.

neration is published to help young executives derstand and adjust to today's business life. It ws you, with personal stories, what other men doing. It examines the problems a man faces ly in his business career, and it showcases the portunities in business for young men.

or example, one issue told the story of Jerome stle, 33-year-old president of the $300-million n-Dixie Cement Company—who believes that anagement Is Like Running Race Horses." In age of decentralized management he breaks the rules, runs a centralized one-man operation, d makes it work.

the same issue, "The Decision Room" was an -opening report on a new management-informa. technique more and more companies are using give their executives the facts they need to make elligent decisions.

ent issues have carried stories about:

stress on the top men . . . how "Executive ock" is reaching into middle management . and the disease of civilization is costing siness far too much as executives fall by wayside.

. corporate politics and whether "To Play Not to Play" . . . the good side and the bad e . . . the way to use office politics construcely . . . for yourself and your company . . .

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life. To these goals, Angelenos, perhaps more than the rest of Americans, are glowingly habituated. Whether smog is considered one of those comforts—indeed, whether it is the price of those comforts—is not a point to raise in polite company. In Los Angeles it is always more comfortable to ignore the pollution or deny the seriousness of the threat than to face the deeper issues raised by its foul existence. Thus, a 1970 ballot proposal that would have allowed local governments to use a fixed percentage of gasoline tax revenues for research, and for a pilot study of mass transit and other alternatives to the automobile, was soundly defeated by southern California. A highly financed propaganda barrage against the plan was put on by the Southern California Auto Club in combination with oil, concrete, and highway interests.

It only takes one or two nice days and Angelenos forget all about air pollution as they roar down to the overcrowded beaches. Unlike the rumbles of doom that emanate from the San Andreas fault—shakes that are an immediate threat to property values and thereby really upset people—living with smog has become a fully accepted way of life in the basin. This is so even if, by order of the county school board, children are forbidden to run, skip, or jump on ozone alert days.

Nevertheless, the war on smog is being fought hard and bombastically. Comprehensive smog bulletins and forecasts are carried daily in Los Angeles newspapers and on local radio and television. Alert levels are precisely stated, and the day's highs and lows are carefully recorded. It is almost as if measuring the malady is, in itself, enough to cure it. Los Angeles has some of the toughest air pollution standards to be found anywhere in the nation, but despite some real battle gains, it is a losing war. The great barrier mountains back up the fouled atmosphere, while overflowing, hot desert air tends to clamp a stationary lid over the basin. The chemical action of sunshine, plus politics, does the rest.

For one thing, the population flood into southern California continues, despite a recent slowdown. It is spurred by an irrepressibly optimistic (or blind) Chamber of Commerce and a state master plan for diverting waters from northern California rivers to the parched
lands of the south. The water plan h
been unsuccessfully opposed by c
cerned environmentalists and northe
state interests. But northern Califor
just does not have the population to e
ert the necessary muscle in the sta
legislature. Indeed, water planning
California is a liquid example of an e
logically destructive, but beautiful
self-fulfilling, prophecy. It begins wi
the unquestioned assumption of "ine
table growth": (1) Southern Califor
is going to have more and more peop
(2) therefore we must project futu
needs from present trends and plan
expand water and other services in
cordance; (3) this planning insures t
more industry and more people will
attracted to southern California, t
justifying the original assumption. M
people mean more cars and more s
vices, which, in turn, bring m
people—and so on. The result
planned and guaranteed pollution
pansion and overcrowding.

For the Los Angeles Basin, the i
mediate, critical threat comes fr
cars. Unlike many cities with belchi
smokestacks and other direct, facto
caused air pollution problems, 85 p
cent of the difficulty in Los Angeles c
be attributed directly to the motor
hicle. The metropolitan area Air Pol
tion Control District (APCD) prides
self on its control of stationary polluti
sources and on a measured decrea
over the past 15 years, in pounds
smog produced per person in the bas
On an average day, the 7 million peo
of Los Angeles County pump about
million pounds of smoke and soot i
the air, a decrease over the period

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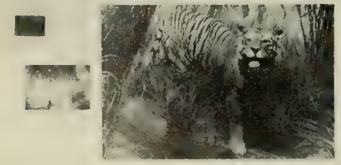

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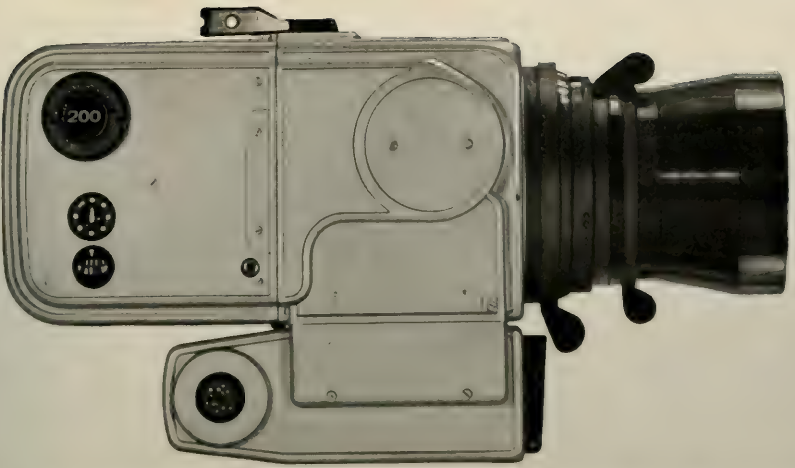
from 4.9 to 3.2 pounds of smog for every man, woman, and child in the area. Since 1955, population in the county has increased about 36 percent, while the number of cars has increased almost 70 percent. But daily smog production is up "only" a million pounds per day since 1955, a mere 4 percent according to APCD bulletins.

Nevertheless, as is true of many a statistical victory, the question remains of what it all means. To the millions of sufferers from air pollution and poisoning, it is of little comfort to know that per capita production of smog is down. The harsher truth is that the amount of "capita" in the basin is way up.

Geographic conditions make the Los Angeles Basin a form of gas trap or gas chamber. Despite reductions in emissions achieved by requiring mechanical devices on vehicles powered by internal combustion, the increasing demand for cars can only work toward an ultimate and tragic day of reckoning. What auto manufacturers and the politicians seem to be focusing on is how to make the best of a worsening situation. What they should be discussing is emergency action aimed at removing the causative factors before the city is faced with disaster. Recent evidence on the nature and effects of internal-combustion engine pollution should give the public serious cause for alarm.

Scientific studies have established that by far the largest number of particles in polluted air are completely invisible to the naked eye. Despite their smokeless appearance, emissions from internal-combustion engines and smokestacks produce vast quantities of tiny particles. These drift in the air for months, or even years, as they are relatively unaffected by gravity. And b
cause of their size, they are easily ab
to enter and irritate the deepest ar
smallest passages of the lungs. Indeed,
single tiny, but visible, piece of exhaus
perhaps one-eighth of an inch, can l
further burned and vaporized into se
eral million—or even billion—invisib
particles! Thus the conversion of visib
exhaust or smoke into invisible vap
through additional burning, may a
tually worsen the smog situation. Wh
is really needed is a system of produ
ing larger particles that cannot becon
suspended in the air, but which w
drop of their own weight and be c
lected. Better still is the external-con
bustion engine or other power sour
that simply does not produce the tr
mendous volume of waste intrinsic
automobile engines now in use.

Vincent J. Schaefer, director of t
Atmospheric Science Research Cent
of the State University of New York
Albany, brought the dangers of sma
particle pollution to the attention of t
U.S. Senate Subcommittee on Air a
Water Pollution in early 1970. B
over a period of time, the impact of l
testimony seems to have been lost
the press, industry, and the politic
leaders of our great cities. Indeed, t
predominant effort today is toward
ductions in visible burnings, even as t
drift of discussion takes the form o
public preening about how mu
money is being spent to get rid of v
ible smoke trails. The shift in exhau
patterns from large to very small p
ticles has resulted in air sampling m
surements that can be very misleadi
What is really happening, Schae
warns, is that pollution stays suspend
longer and falls farther downwind fr



This is the Hasselblad that went to the moon.

This is the part that came back.

…e camera up above is the …selblad 500EL electrically-…n space camera.

…s the camera the astronauts … on the moon.

…s also the camera they left …nd.

…nly about a third of it came … .

…ut then the Apollo rocket that …ed it was 365' tall when it …for the moon. And only 10' … when it returned. So the …selblad didn't make out too …y, considering.

…e back of the Hasselblad is … part that came back. A de-…able film magazine that as-…d the safety of the film. And … necessary because the astro-…s' bulky gloves would have made it difficult to remove film in any other way. (To appreciate the problem, try unloading your own camera wearing hockey gloves.)

As valuable as it proved to be, the removable back isn't something that was designed for NASA. Every Hasselblad on earth is made that way.

Not only can the back of any Hasselblad be removed, but it can be interchanged with any of four other film magazines. Which lets you do things that weren't possible before.

There you are down at the water hole, photographing a rhino in black and white. When suddenly a red-billed oxpecker lands on its back. You'd love to switch to color, but you're only halfway through your roll, and you don't want to waste the rest of it.

With a Hasselblad you can simply take off the back in one second, and snap on a new one pre-loaded with color film. Then when the oxpecker flies off, you can switch back to black and white again.

And you haven't lost a single shot.

The backs even let you decide on the size and shape of your shot. You can pick a big 2¼" square. Or a rectangle 1⅝" x 2¼". Or make super slides 1⅝" x 1⅝" (they're 50% larger than ordinary slides, yet fit all standard projectors).

You can also choose the number of exposures you want, 12, 16, 24 right on up to 70. This last magazine is great for shooting continuous action, like the rhino coming to have a closer look at you.

The front, top and sides of the Hasselblad give you as many possibilities as the back. The front accepts ten different Carl Zeiss lenses, each with its own built-in Compur shutter, synchronized for flash and strobe at all speeds.

The top accepts five different viewers and two different focusing screens. And the side takes three different film advance mechanisms. These components, together with accessories and three different camera bodies, add up to the Hasselblad System.

Within the system, the 500ELM electrically-driven earth camera —cousin to the moon camera— can do a few things that even the other Hasselblads can't do.

Because this camera is electrically-operated, it can be triggered from a distance through the use of long release cords or remote radio control. And because the camera readies itself for the next shot automatically, you can shoot as many as 70 consecutive exposures without being anywhere near the camera. Which is a good way to get a shot of the rhino coming towards you, without having to be the one it's coming towards.

So you can see that the Hasselblad has even more application on earth than on the moon.

And another nice thing about using a Hasselblad on earth is that when you come back with your pictures, you also come back with your Hasselblad.

For more information, see your Hasselblad dealer. For his name, and a free 48-page catalog on The Hasselblad System, write to address below.

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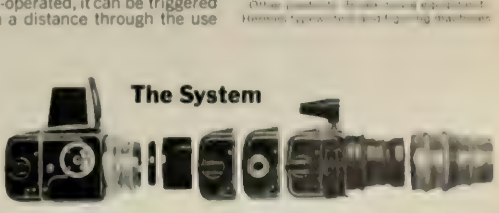

its source. As a result, it is not being fully measured in the cities where it is produced, and until very recently, its submicron size made it very difficult to detect. Thus, if the wind is toward the east, the desert resort community of Palm Springs, some 90 miles away, now regularly can be expected to fume while Los Angeles sizzles.

But the smoggy outfall has more than local influence and danger. Because it hangs in suspension for indefinitely long periods of time, the small-particle pollution has formed "all pervasive bluish and grayish hazes" that not o hang over and near metropolitan ar but frequently stretch 500 to 1,0 miles across the country. Yet, as in t case of Los Angeles, there may not b single visible smoke source. Schae cautions that massive areas of ice cr tals are today frequently encountered low atmospheric levels. These conc trated crystals have already been tected as the cause of misty rains a light snows, and they may well h drastic implications for basic weat and storm patterns. The proba source of the ice nuclei is identified automobile exhausts from leaded ga

The Smithsonian Institution recorded that since 1910 the amoun sunlight striking the Washington M has decreased 16 percent. At the op site end of the continent, the la "sunny California" is much more idly becoming an embarrassing nomer.

To date, attempts at mechanical c trol of exhaust emissions have produ mixed results. Over a five-year peri there have been some significant red tions in such engine pollutants as

Continued on page

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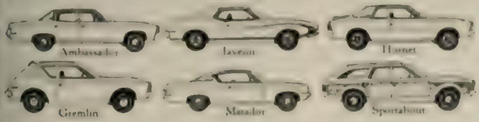

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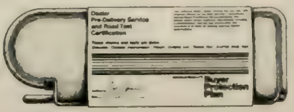

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Creature from the Marsh

by Loren Eiseley

The skull was black when they brought it to me. It was black from the irons and acids and mineral replacements of ice-age gravels. It was polished and worn and gleaming from the alterations of unnumbered years. It had made strange journeys after the death of its occupant; it had moved with glacial slowness in the beds of rivers; it had been tumbled by floods and, becoming an object of grisly beauty, had been picked up and passed from hand to hand by men the individual had never seen in life.

Finally it was brought to me.

It was my duty to tell them about the skull.

It was my professional duty to clothe these bones once more with the faint essence of a personality, to speak of a man or a woman, young or old, as the bones might tell the story. It was my task to read the racial features in a forgotten face, stare deep into the hollow sockets through which had once passed in endless procession the days and seasons and the shed tears of long ago.

The woman had been young. I could tell them that. I could tell them she had once fallen or been struck, and that after a long time the bone had mended and she had recovered—how, it was difficult to say, for it had been a dangerous and compound fracture. Today such a wound would mean months of immobilization in a hospital. This woman had survived without medical attention through the endless marchings and journeyings of the hunters' world. She had endured and lived on toward some doom that had come fast upon her but was not written in the bones. It was, in all likelihood, a death by violence. Her skull had not been drawn from a grave. It had come from beneath the restless waters of a giant river that is known to keep its secrets well.

They asked me for the time of these events, and again, obediently, I went down that frail ladder that stretches below us into the night of time. I went slowly, by groping deductions and the hesitant intuitions of long experience that only scholars know. I passed through ages where water was wearing away the shapes of river pebbles into crystalline sand and the only sound in the autumn thickets was the gathering of south-flying birds. Somewhere in the neighborhood of the five thousandth millennium—I could place it no closer than that—the ladder failed me. The river was still there but larger—an enormous rolling waste of water and marshes out of which rose a vast October moon.

They interrupted me then, querulously, asking if archeologists could do no better than this, and was it not true that there were new and clever methods by which physicists could call the year in the century and mark the passage of time by the tick of atoms in the substance of things. And I said, yes, within limits it was true, but that the methods were not always usable, and that the subtle contaminations possible among radioactive objects sometimes defeate our attempts.

At this point they shook their head unwillingly, for, as I quickly saw, the had the passion of modern men for th precision of machines and dislike vagueness of any sort. But the skull la there on the table between us, and ove it one man lingered, fascinated in spit of himself. I knew what he was thinking: Where am I going? When shall become like this?

I heard this in his mind for just a instant while I stared across at hi from among my boxes of teeth and fli arrowheads, which had grown chalk and dull with the passage of long ce turies in the ground.

"Thank you," the visitor said finall moving after his party to the door. H was, I saw, unsure for what it was h thanked me.

"You are quite welcome," I said, sti returning slowly from that waste of fo gotten water over which the birds another century cried dolefully, so th I could hear them keening in my hea Like the man who asks a medium bring back some whimpering mem ryless ghost and make it speak out of living mouth for the amusement of group of curiosity seekers, he may hav felt remorse. At any rate, he nodde uncertainly and fled.

I was the instrument. I had made th journey a hundred times for studen who scrawled their initials on my skull a hundred times for reporters wh wanted sensational accounts of mo key-men, a hundred times for peop

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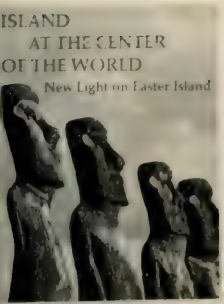

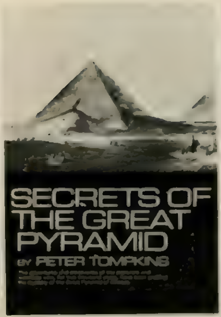

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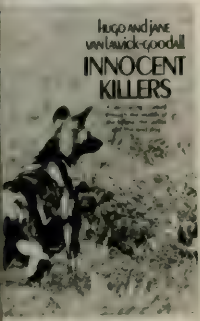

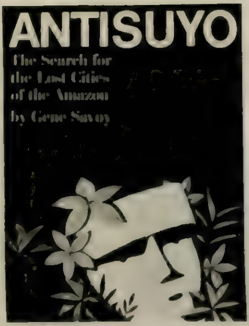

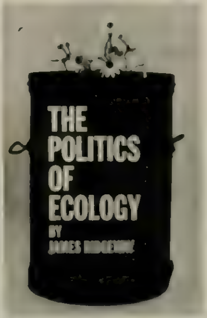

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who came up at the end of lectures and asked, "How much are the bones, worth, doctor? Are they easy to find?"

In spite of this I have continued to make these journeys. It is old habit now. I go back into the past alone. I would do it if I fled my job and sought safety in some obscure room. My sense of time is so heightened that I can feel the frost at work in stones, the first creeping advance of grass in a deserted street. I have stood by the carved sarcophagi of dead knights in a European cathedral, men seven hundred years away from us, with their steel and their ladies, and from that point striven to hurl the mind still backward into the wilderness where man coughs bestially and vanishes into the shape of beasts.

I cannot say I am a student of the dates in the history books. My life is mostly occupied with caves filled up and drifted over with the leaves of ten thousand autumns. My specialty is the time when man was changing into man.

"The greatest prize of all," once confessed the British plant explorer F Kingdon Ward, "is the skull of primitive man." Ward forgot one thing There are other clues to primitive men than those confined to skulls. Th bones of fossil men are few because th earth tolerated them in scant numbers We call them missing links on the road to ourselves. A little less tooth here, little more brain there, and you can se them changing toward ourselves in tha long, historyless time when the grea continental ice sheets ebbed and flowe across the northern continents. Like a the students of that age, I wanted t find a missing link in human history That is what this record is about, for stumbled on the track of one.

Some men would maintain that vague thing called atmosphere account for such an episode as I am about to relate, that there are houses that deman a murder and wait patiently until th murderer and his victim arrive, tha there are great cliffs that draw the potential suicide from afar or mountain of so austere a nature that they writ their message on the face of a man wh looks up at them. This all may be. I c not deny it. But when I encountere the footprint in the mud of that remo place I think the thing that terrified m most was that I knew to whom it b longed, and yet I did not want to kno him. He was a stranger to me and r mains so to this day. Because of a ce tain knowledge I had, however, he su ceeded in impressing himself upon m in a most insidious manner. I ha ver been the same since the event ok place, and often at night I start up eating and think uncannily that the ature is there with me in the dark. If sense of his presence grows, I itch on the light, but I never look o the mirror. This is a matter of old bit with me.

First off, though, we must get straight at we mean by a missing link.

A missing link is a day in the life of a cies that is changing its form and bits, just as, on a smaller scale, one's earance and behavior at the age of is a link in one's development to an lt man or woman. The individual son may have changed and grown, still the boy or girl of many years is linked to the present by a long ies of steps. And if one is really alive not already a living fossil, one will on changing till the end of one's life l perhaps be the better for it. The m "missing link" was coined bese some of the physical links in the tory of man as a species are lost, and se people who, like myself, are ious about the past look for them.

My album is the earth, and the pices in it are faded and badly torn and e to be pieced together by detective rk. If one thinks of oneself at five rs of age, one may get a thin wisp of connected memory pictures. By cont, the past of a living species is with memory except as that past has tten its physical record in vestigial ans like the appendix or a certain tern on our molar teeth. To eke out at those physical stigmata tell us, we e to go grubbing about in caves and vel for the bones of very ancient n. If one can conceive of the trouble archeologist might have in locating 's remains a half-million years from v, supposing they still existed, one l get an idea of the difficulties inved in finding traces of man before bones were crowded together in es and cemeteries.

was wandering inland along a ken shore when the thing hapned—the thing I had frequently ght. In other words, I got a clue to n. The beaches on that coast I had ne to visit are treacherous and sandy, l the tides are always shifting things ut among the mangrove roots. It is a place to which I would willingly urn and you will get no bearings m me. Anyway, what it was I found re could be discovered on any man's st if he looked sharp for it. I had ne to that place with other things in d and a notion of being alone. I was

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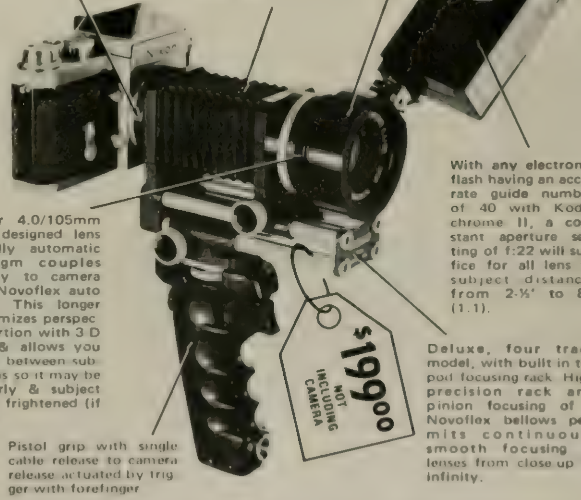

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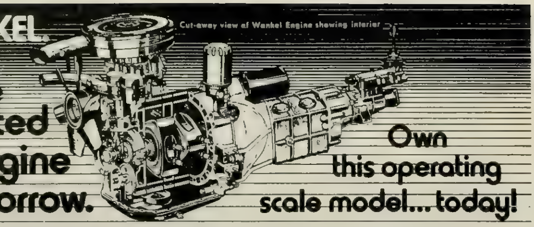
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tired. I wanted to lie in the sun or clar ber about like an animal in the swam and the forest. To secure such rest fro the turmoil of a modern city is the mo difficult thing in the world to acco plish, and I have only achieved it twic once in one of the most absolute dese in the world and again in this tropic marsh.

By day and night strange forms life scuttled and gurgled underfoot oozed wetly along outthrust branche luminous tropical insects blundered in the dark like the lamps of hesita burglars. Overhead, on higher groun another life shrieked distantly or w expectantly still in the treetops. Son how, alone as I was, I got to listening if all that world were listening, waiti for something to happen. The tr drooped a little lower listening, the ti lurked and hesitated on the beach, a even a tree snake dropped a loop a hung with his face behind a spider w immobile in the still air.

A world like that is not really na ral, or (the thought strikes one lat perhaps it really is, only more so. Pa of it are neither land nor sea and so erything is moving from one element another, wearing uneasily the qu transitional bodies that life adopts such places. Fish, some of them, co out and breathe air and sit about wat ing you. Plants take to eating inse mammals go back to the water a grow elongate like fish, crabs cli trees. Nothing stays put where it beg because everything is constantly clir ing in, or climbing out of, its unsta environment.

Along drowned coasts of this vari you only see, in a sort of speeded way, what is true of the whole wo and everything upon it: the Darwin world of passage, of missing links, beetles with soldered, flightless wir of snakes with vestigial feet dragg slowly through the underbrush. Eve thing is marred and maimed slightly out of focus—everything in world. As for man, he is no differ from the rest. His back aches, he r tures easily, his women have difficul in childbirth, all because he struggled up upon his hind legs with having achieved a perfect adjustmen his new posture.

On this particular afternoon, I ca upon a swamp full of huge water li where I had once before ventured. wind had begun to rise and rain falling at intervals. As far as I co see, giant green leaves velvetly pervious to water were rolling

ıe Seymours just gave birth to a nine-year-old.

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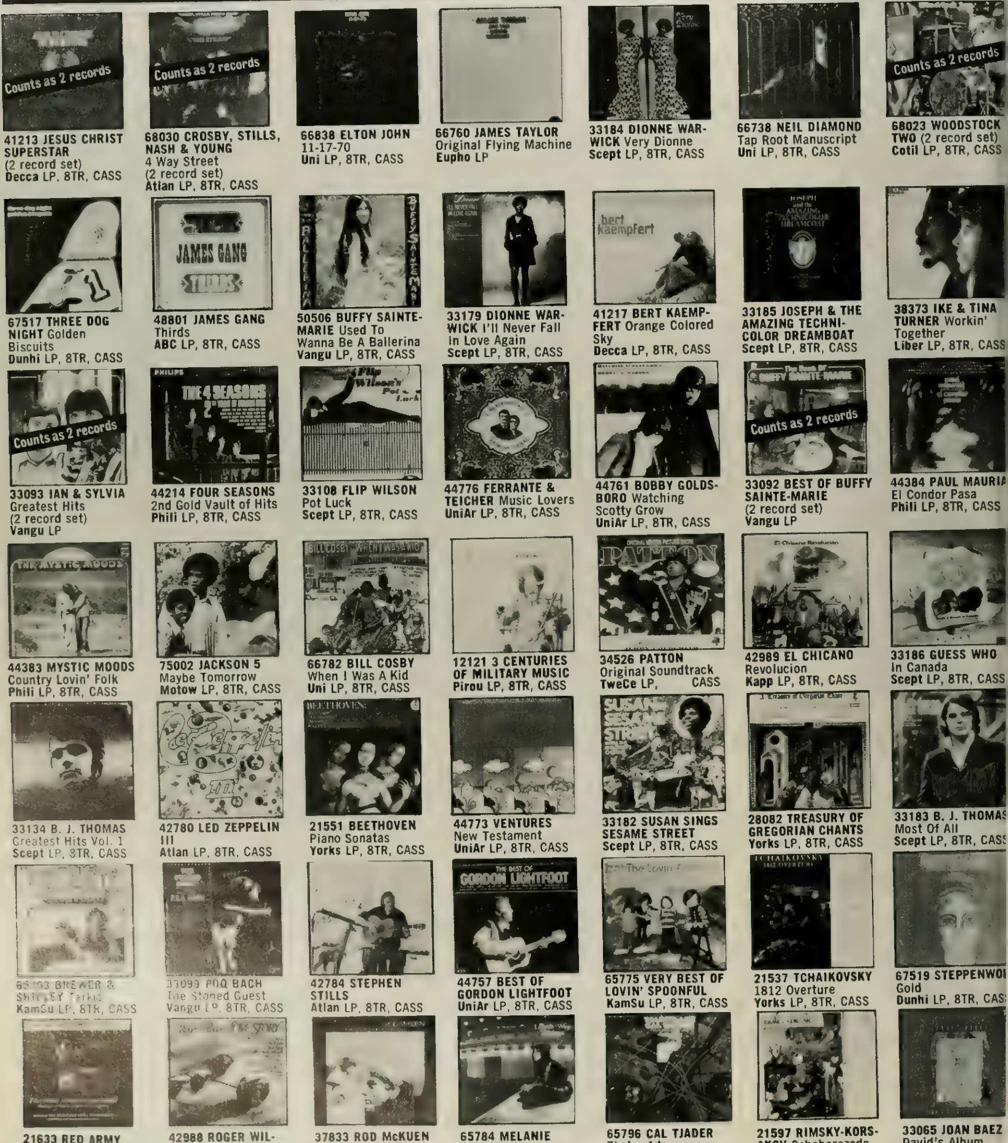

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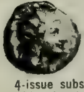

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twisting in the wind. The species of lily was one in which part of the leaves project on stalks for a short distance above the water, and as they rolled and tossed, the whole swamp flashed and quivered from the innumerable water drops that were rolling around and around like quicksilver in the great cupped leaves. Everything seemed flickering and changing as if in some gigantic illusion, but so soft was the green light and so delicate the brushing of the leaves against each other that the whole effect was quite restful, as though one could be assured that nothing was actually tangible or real, and no one in his senses would want it to be so long as he could sway and nod and roll reflecting water drops about over the surface of his brain.

Just as I finally turned away to climb a little ridge I found the first footprint. It was in a patch of damp exposed mud and was pointed away from the water as though the creature had emerged directly out of the swamp and was heading up the shore toward the interior. I had thought I was alone, and in that place it was wise to know one's neighbors. Worst of all, as I stood studying the footprint, and then another, still heading up the little rise, it struck me that though undoubtedly human the prints were different in some indefinable way. I will tell you once more that this happened on the coast of another country in a place where form itself is an illusion and no shape of man or beast is totally impossible. I crouched anxiously in the mud while all about the great leaves continued to rotate on their stems and to flash their endlessly rolling jewels.

But there were these footprints. They did not disappear. As I fixed the lowermost print with every iota of scientific attention I could muster, it became increasingly apparent that I was dealing with some transitional form of man. The arch, as revealed in the soft mud, was low and flat and implied to the skilled eye an inadequate adjustment to the upright posture. This, in its turn, suggested certain things about the spine and the nature of the skull. It was only then, I think, that the full import of my discovery came to me.

Good Lord, I thought consciously for the first time, the thing is alive. I had spent so many years analyzing the bones of past ages or brooding over lizard tracks turned to stone in remote epochs that I had never contemplated this possibility before. The thing was alive and it was human. I looked uneasily about before settling down into the mud once more. One could make out that the prints were big but what drew my fascinated eye from the first was the nature of the second toe. It was longer than the big toe, and as I crawled excitedly back and forth between the two wet prints in the open mud, I saw that there was a remaining hint of prehensile flexibility about them.

Most decidedly, as a means of ground locomotion this foot was transitional and imperfect. Its loose, splaye aspect suggested inadequate protectio against sprains. The second toe was unnecessarily long for life on the ground although the little toe was already approximating the rudimentary conditio so characteristic of modern man. Coul it be that I was dealing with an unreported living fossil, an archaic ancestra survival? What else could be walkin the mangrove jungle with a foot that betrayed clearly the marks of ancient intimacy with the arboreal attic, an intimacy so long continued that now after hundreds of thousands of years ground life, the creature had squiggle his unnecessarily long toes about in th mud as though an opportunity to clutc at something had delighted his secre soul.

I crouched by the footprint an thought. I remembered that comparisons with the living fauna, whenever available, are good scientific procedure and a great aid to precise taxonomy. I sat down and took off m shoes.

I had never had much occasion t look critically at my own feet before. I modern man they are generally encase in shoes—something that still suggests slight imperfection in our adaptation After all, we do not normally find it necessary to go about with our hands constantly enclosed in gloves. As I sat contemplating and comparing my feet wit the footprints, a faintly disturbin memory floated hazily across my min It had involved a swimming party man years before at the home of one of th most distinguished comparative anatomists in the world. As we had sat on th bench alongside his pool, I had glance up suddenly and caught him starin with what had seemed unnecessary fa cination at my feet. I remembered no that he had blushed a deep pink und his white hair and had diverted my i quiring glance deftly to the scene about us.

Why I should have remembered th incident at all was unclear to me. Th was no moment for hesitation. Still,

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did hesitate. The uneasy memory grew stronger, and a thought finally struck me. A little sheepishly and with a glance around to see that I was not observed. I lowered my own muddy foot into the footprint. It fitted.

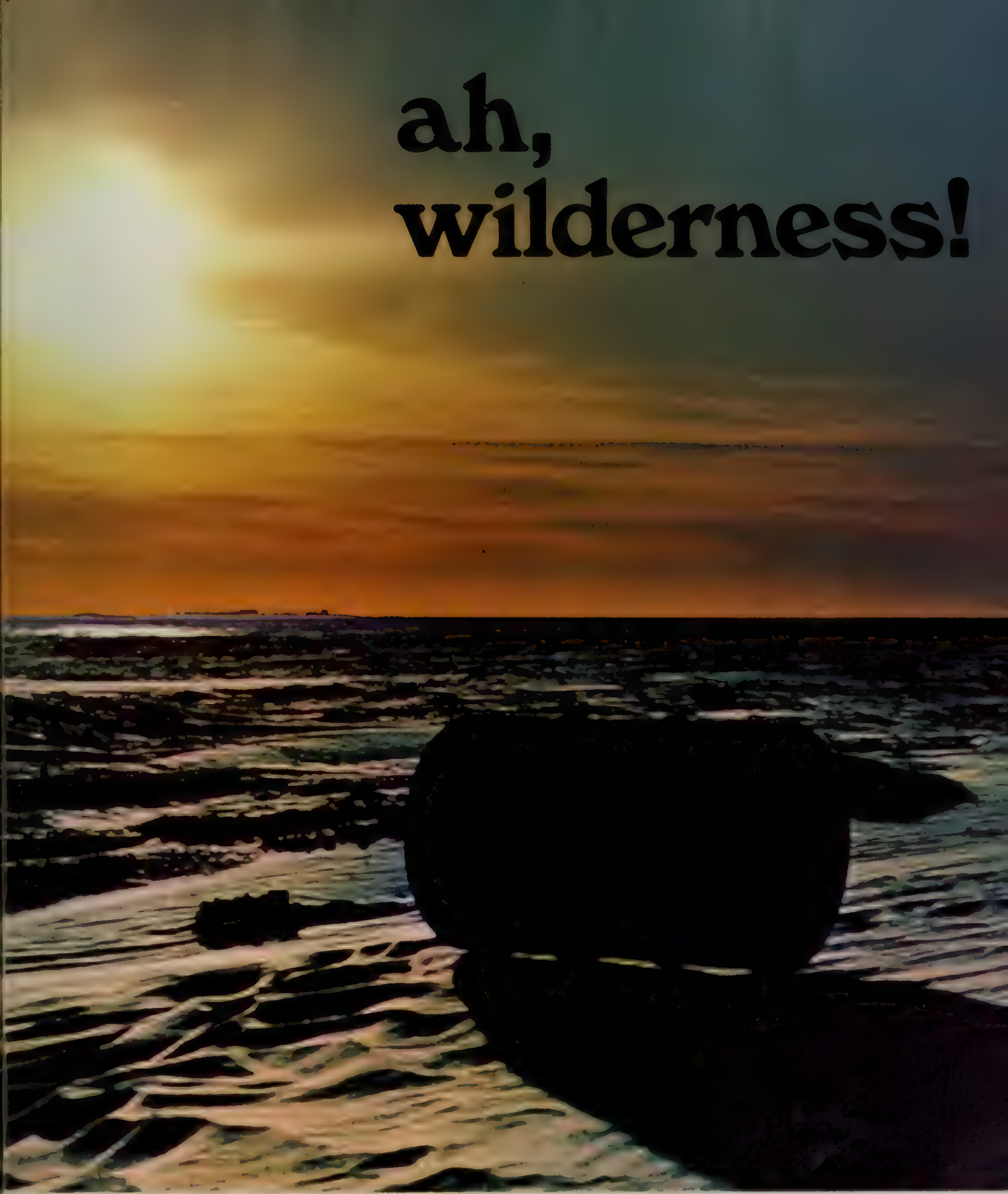
I stood there contemplatively clutching, but this time consciously, the mud in my naked toes. I was the dark being on that island shore whose body carried the marks of its strange passage. I was my own dogging Man Friday, the beast from the past who had come with weapons through the marsh. I took another step through the marsh. The wind had died, and the great green leaves with their rolling jewels were still. The mistake I had made was the mistake of al of us.

The story of man was not all then behind us in the caves of remote epochs. Even our physical bodies gave evidence that the change was not completed. As for our minds, they were stil odd compounds of beast and saint. Bu it was not by turning back toward the marsh out of which we had come tha the truly human kingdom was to be possessed and entered—that kingdom dreamed of in many religions and spoken of in many barbarous tongues. A philosopher had once said in my presence, "The universe is a series of leaping sparks—everything else is interpretation." But what, I hesitated, wa man's interpretation to be?

I drew a foot out of the little steaming swamp that sucked at it. The ai hung heavily about me. I listened as th first beast might have listened wh came from the water up the shore an did not return again to his old element Everything about me listened in tur and seemed to be waiting for some decision on my part. I swayed a moment o unstable footing.

Then, warily, I stepped higher up th shore and let the water and the silt fi in that footprint to make it, a hundred million years away, a fossil sign of a unknown creature slipping from th shadows of a marsh toward somethin else that waited him. I had found th missing link. He walked on misshapen feet. The stones hurt him and his bell sagged. There were dreams like Christmas ornaments in his head, intermingled with an ancient malevolent viciousness. I knew because I was th missing link, but for the first time sensed where I was going.

I have said I never look into the mirror. It is a matter of old habit now. that other presence grows too oppressive, I light the light and read.



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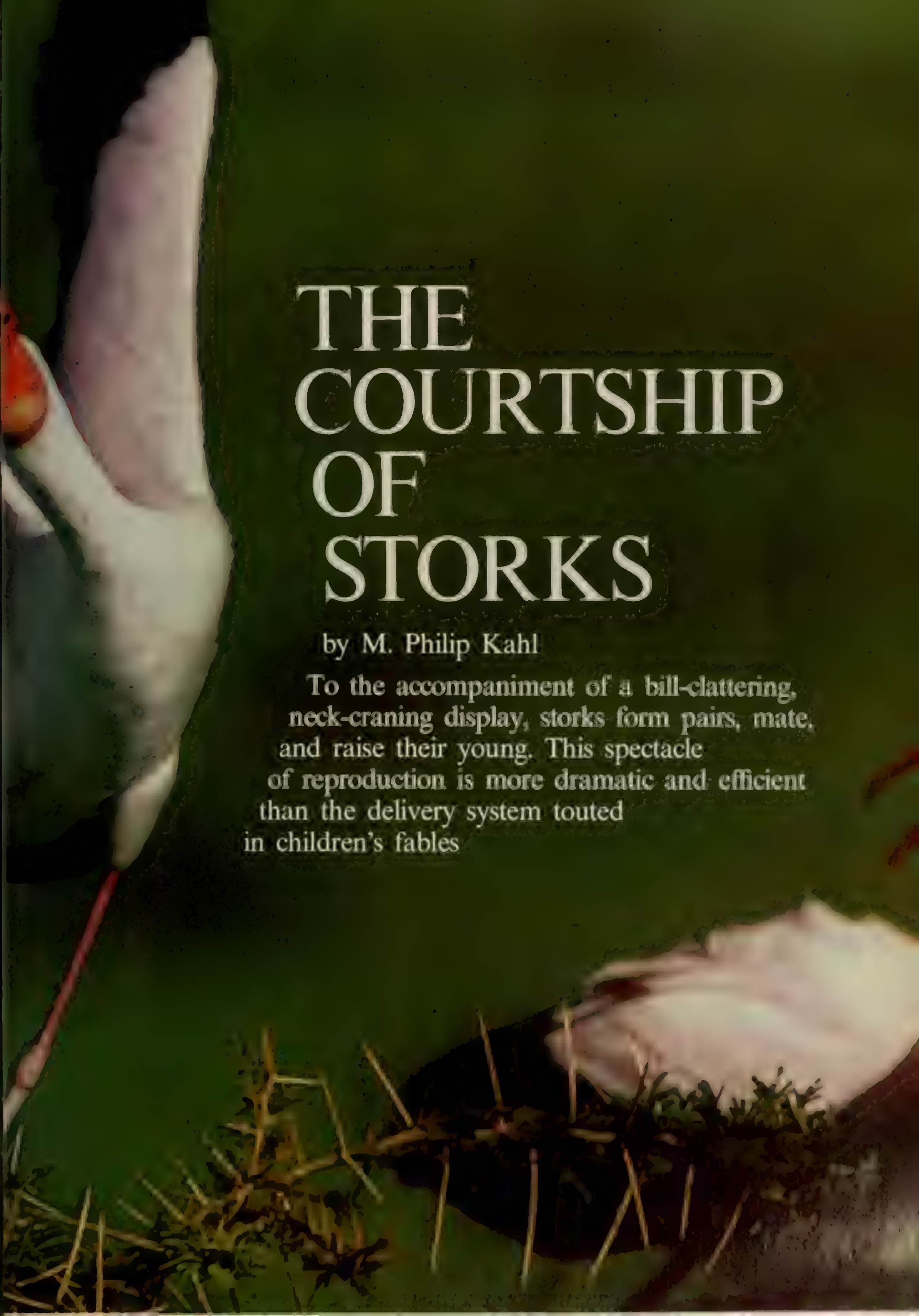


THE COURTSHIP OF STORKS

by M. Philip Kahl

To the accompaniment of a bill-clattering, neck-craning display, storks form pairs, mate, and raise their young. This spectacle of reproduction is more dramatic and efficient than the delivery system touted in children's fables

Many people know the stork mainly as a decoration on greeting cards and from cartoons depicting it in flight with a human baby suspended from its bill. This image, associated with the white stork, derives from the European folk belief that the stork is an omen of good luck, portending many children, particularly boys.

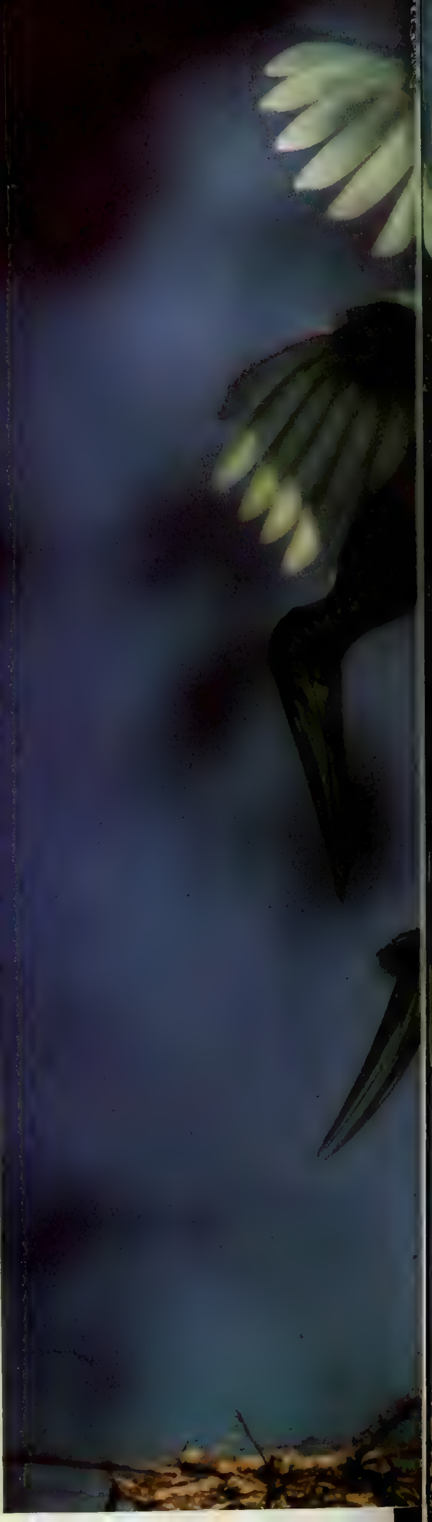
Although many legends about the white stork's ability to supply human babies have been passed on for generations, sustained as cute and convenient ways of avoiding early sex education, relatively little has been written about how storks themselves propagate. These mostly tropical birds have evolved complex patterns of breeding behavior.

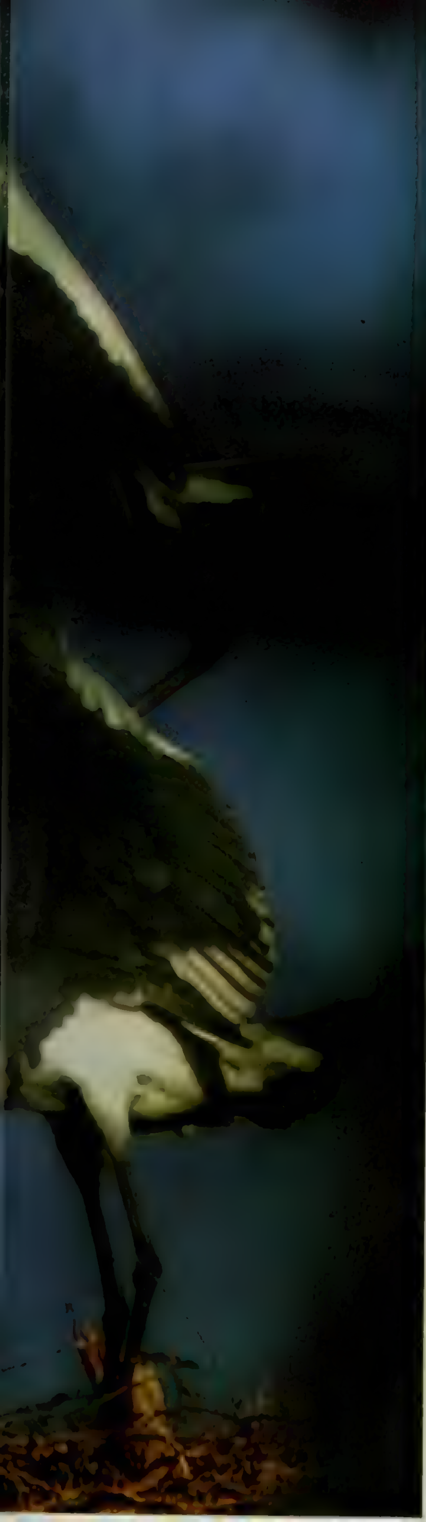
Of the 17 stork species, only two, the white stork and the black stork of Eurasia, regularly leave the tropics in large numbers to nest in temperate regions. They breed only in the spring and summer and migrate back to the tropics, or beyond, to pass the winter. Resident tropical species, however, can nest at any time of the year, depending upon local ecological conditions.

For many tropical residents, food availability seems to be the environmental trigger that determines the timing of their breeding season. With the exception of the insectivorous Abdim's stork, they do not undertake a true seasonal migration; instead, they may wander widely within a general region in search of suitable feeding conditions, then return to their ancestral nesting grounds to raise a family.

The wood storks of Florida, for example, scatter throughout the southeast, mostly along the Atlantic and Gulf coasts, during late summer when water levels are high and their fish food is widely dispersed. At the beginning of the dry season in early winter, the wood storks return to their southern Florida nesting sites and commence to breed. Egg laying may be earlier or later in a given year, depending on when the rains end and the water levels start to fall. As the marshes dry up, fish populations become highly concentrated, furnishing abundant fare for the birds. It is apparently this increase in food availability that triggers the wood storks' reproductive cycle, for in winters following inadequate summer rains, when few fish are produced, the birds do not congregate at nesting areas and may fail to breed entirely.

Similar environmental triggers are at work for the yellowbilled stork of Africa and the painted stork of India. These birds are similar to the wood stork in their ecological requirements, and their breeding seasons also seem to be triggered by an increase in available food. Owing to the different topography of their habitats, however, the fish upon which these birds feed are most available during the rainy season. Southern Florida is extremely flat, with few lakes, rivers, or other bodies of permanent water; fish are therefore widely dispersed in the wet season and





Atop a 20-foot palm tree in northern Argentina, a male jabiru stork jockeys into position for mounting his waiting mate. Copulation is frequent once the female's advances have been accepted and a pair-bond formed.

highly concentrated during the dry season. The availability of fish for the yellowbilled and painted storks, however, is governed by the lakes and rivers of their habitats: the fish retreat to these deeper bodies of water at the onset of the dry season, making it difficult for the birds to reach them. Only with the first flooding of the rainy season do the fish enter shallower marshes to spawn and become available to the birds. Thus, these three similar stork species respond to the same environmental trigger of food availability, but because of differing ecological conditions, they do so at different stages in the wet-dry annual cycle.

Conversely, marabou storks nesting in western Kenya only a few miles from yellowbilled stork colonies usually have large young in the nest, almost ready to fly, before the yellowbills have even laid eggs. The marabous, being largely scavengers, nest during the local dry season when their food is most concentrated around drying water holes and at grass fires.

Whenever their respective breeding seasons arrive, all storks enter a similar process of courtship and pair-formation. Some, such as the solitary nesting saddlebill, blacknecked, and jabiru storks, probably mate for life; thus, the process of pair-formation does not take place every year. The colonial species, however, seem to choose a new mate each season and, in some, courtship and pair-formation is a prolonged and elaborate affair.

Courtship in storks can perhaps be best exemplified by choosing a "model" stork and following the actions of a typical pair from arrival at the breeding site until egg laying. For such a model, I have chosen the painted stork, which I studied at Bharatpur, India, for two seasons.

In August of most years, when the monsoon rains have flooded the area around the nest trees, flocks of painted storks begin arriving at the colony site from all points of the compass. Some may have spent the dry season as far as several hundred miles away in search of favorable feeding areas. Now, as they arrive back at Bharatpur, most have acquired the bright, new black, white, and pink plumage of their nuptial dress. Their naked heads and necks are a brilliant reddish orange and their legs a deeper magenta.

"Bachelor parties" of unmated males and females gather in the low acacia trees, which were filled with nests in the previous season. Weathering over the

past year, plus the ravages of other birds pilfering sticks for their own nests, has reduced last year's flimsy nest platforms to mere remnants. Immediately after a bachelor party lands in a tree, males begin to jockey for nest sites—fighting, flapping, and supplanting each other. Any nest foundations that do remain from the previous season are quickly appropriated by the more aggressive males.

At first the established males behave aggressively to all other storks—male and female alike—attacking and driving away those that approach too closely. Other, nonestablished males often fight back; sometimes they succeed in driving off the original male. Each male that acquires a nest site begins to "advertise" his status almost at once by repeating two ritualized and stereotyped displays. At first glance, these movements do not appear to be displays: it looks as if the bird is just arranging its plumage and testing the stability of nest sticks or nearby twigs. If one watches closely, however, it can be seen that the movements are formalized and tensely executed, and often do not complete the action they appear to serve.

For example, the male repeatedly preens the primary feathers of one wing by stripping them down from the front with his bill. If you glance around the tree, you will see other males performing the same "display preening" operation, and each is making the downward movements at precisely the same rate, keeping pace with nearby birds. A closer look will show that often the bird is not actually touching the primaries with its bill, but is only "pretending" to preen them. After a long series of display preens on one side, the male shifts to the other wing, repeating the process there. Should a female land nearby or approach, the male's display intensifies, with the amplitude of the downstrokes becoming greater and the movements becoming even more tense and stiff.

Between bouts of display preening, the male bends forward and slightly to one side of center and grasps lightly at a nest stick or nearby twig. He then releases his hold, pivots slowly to the other side, and grasps another stick. This process may continue for several minutes, and when performed with irregular intervals between movements it is difficult for the observer to realize that he is witnessing a true display. Motion pictures viewed at a faster than normal speed, however, clearly reveal the nature of this behavior. With the exception of the saddlebilled and blacknecked storks, male and female storks are essentially alike in appearance, and the birds probably

The East African dry season acts as an environmental trigger on marabous, spurring them to nest. Lakes and water holes shrink in size, and carrion, such as dead flamingoes, becomes concentrated and easily accessible.

ales make frequent trips to gather nest-building materials after
ating compatability is established. This acacia tree on a shamba,
little farm, in western Kenya is shared by 15 pairs of nesting marabous.
he waste from a slaughterhouse 200 yards away attracts these scavengers.

use courting behavior as a clue to sexual identity.

When one or more females have been attracted to a performing male, they alight on nearby limbs. As she draws nearer to the male, the female stands with her head held low, wings widely spread, and bill gaping. A short time after landing or moving along a limb, the female may close her wings, but if she remains near a courting male, she continues gaping for long periods. Should the female edge too close, too quickly, the male will probably drive her away with a vicious grab. Courting females do not fight back, however. They approach slowly, usually in a ritualized submissive posture; if attacked by the male, they merely retreat to a nearby perch, wait a short time, and then attempt to approach the male again. Such females often receive harsh treatment from their prospective mates, but they "won't take no for an answer!" They return again and again.

Some males are more aggressive than others, and I have witnessed males driving courting females away for days with vicious attacks. Feathers may fly and blood may even flow, but rarely, if ever, does the female fight back to defend herself. She merely flies away, waits patiently, and later tries again.

At last the female's patience is rewarded and the male allows her to step into the nest. This is a critical moment in the formation of the pair. Initially, both birds appear tense and on edge, and any sudden movement or miscalculation by the female may precipitate another attack by the male.

Frequently, midway through this process of pair-formation, the birds are disturbed by the intrusion of another stork; or the entire bachelor party may leave, a few birds at a time, and form in another, nearby tree. In such cases, the chain of events is broken and the process must start anew. But the persistent, repeated, and gradual approaches of the female allow her to rejoin the male on the new nest site. Each pair-formation, consequently, usually spans several hours or even days.

When fighting stops and a compatible pair is finally formed, they begin mutual greeting displays and copulation becomes frequent—as often as three or four times per hour whenever both birds are on the nest. With the passage of time, and numerous copulations, the female gains the male's complete acceptance. The male then shifts to another phase of the nesting sequence: he begins to gather sticks for the nest.

A few sticks may have been added to the platform before a female was accepted, but nest building starts in earnest only after a mate is acquired. At this point, the male leaves the female alone on the nest between copulations and makes repeated expeditions to gather sticks. As the male returns to the nest with a stick, the birds greet each other with a mutual display, which in most storks includes snapping or clattering of the bill and raising and lowering of the head. Owing to the head movements, I have termed the homologous, or closely related, forms of this greeting ritual in the various species the up-down display. The form of the up-down shows wide diversity among the 17 species of storks, but there are enough similarities to indicate that it is, indeed, a homologous display that has undergone species-specific changes through evolution.

The up-down is shown in its simplest and probably most primitive form by the two openbills and the four wood storks. In these six species the display consists mainly of lifting the head and gaping the bill skyward, uttering a series of short and simple vocalizations, and then lowering the head until the bill reaches almost to the floor of the nest. In the openbills and the American wood stork, no bill snapping or clattering is heard during the up-down. The yellowbilled stork incorporates single or double snaps of the bill between vocalizations as the bill and head are lowered. And in the painted and milky storks these snaps become multiplied into short bill rattles or bursts of bill clattering.

Bill clattering during the up-down is shown to a greater or lesser extent by all other storks, and reaches its peak of development in the prolonged series of bill clatterings heard from the white stork on European rooftops. In this display, which may last up to ten seconds, the birds throw their heads up and back until the crown is resting on the back feathers, then the head is thrown forward again to the normal position, with loud bill clattering continuing all the while.

Another bizarre up-down is given by the black-necked stork of Asia. In this species the head remains approximately in the normal position throughout the clattering, but the wings are widely spread to the

ack storks are the only stork species that nest in deep woods.
ey frequently construct nests on the open branches of large oaks,
h as this one in a forest near Milicz, Poland.

sides and flutter rapidly during the display. Since the blacknecked is one of the tallest of all the storks and has pure white primary and secondary wing feathers, the display is especially spectacular.

The saddlebill stork, the close African cousin of the blacknecked, will probably be found to possess a similar up-down. At the present time, however, the saddlebill remains the only species of stork for which the up-down has not been described.

A few days after copulation begins, the female starts to lay eggs, which appear singly at intervals of about two days until the completed clutch of three or four eggs is laid. The pair continues to engage in some displays during this period, and even the young, one day after hatching, exchange displays with their parents. The up-down is the primary display retained by the adults during the period of egg laying, incubation, and rearing of the young; the function is probably to help maintain and reinforce the pair-bond.

While the prolonged and complicated pairing ceremony may appear to be an unnecessary waste of time, it serves several useful biological functions. Not only does it help to synchronize the physiological states of the participating birds but it also prevents "mistakes" in a mixed colony of closely related species. Since each stork has its own species-specific set of genetically influenced courtship displays, the formation of hybrid pairs is effectively prevented. The male of one species has the "key" that will fit only the "lock" of a female of the same species.

It is often possible to speculate, with a fair degree of accuracy, on the evolutionary pathways by which each display has developed. In the painted stork the display-preening and twig-grasping ceremonies of the male probably evolved from true preening and nest-building movements. The gaping and open wing postures of the female may have evolved from panting and balancing movements. Each movement or posture has taken on the new function of social communication in the behavioral repertoire of the species and is largely, if not fully, emancipated from its original context and function. For instance, gaping, which probably originated from thermoregulatory panting, now occurs during courtship even when the weather is cool and the bird is not overheated.

Since much of this highly ritualized, stereotyped, and species-specific behavior is genetically influenced, it is often more helpful than morphology in determining the relationships and differences between the various species. Based upon newly acquired behavioral evidence, for example, several changes in the previously accepted taxonomic classification of the storks would now seem to be in order.

The most recent, widely accepted classification of the storks was that of Peters's *Check List of Birds of the World,* published in 1931. Peters's treatments were based largely on morphological evidence, for little was known at the time about most stork species in the wild. Consequently, some anatomical differences were overemphasized and some similarities were ignored, without reference to their functional significance in the birds' lives or the rapidity with which they might have changed through evolution.

My studies of the comparative behavior of storks have shed light on some taxonomic relationships within the family that were obscure in the past, when only museum specimens were studied. For example, all four wood storks—the milky, painted, and yellow-billed storks and the American wood stork—share extremely similar courtship displays. This is particularly true of their up-downs in which all the major sequences are shared, with only minor quantitative differences in bill snapping and rattling. All four species, now divided between the two genera *Ibis* and *Mycteria,* should be combined into one, *Mycteria.*

Likewise, the closely related saddlebill and blacknecked storks of Africa and Asia have previously been classified into two monotypic genera, *Ephippiorhynchus* and *Xenorhynchus* respectively. But in addition to certain obvious morphological similarities (such as sexual dimorphism of eye color), they share a "flap-dash" display unique to them and to the jabiru stork of South America. In this display a male, and occasionally a female, runs away from its mate when both are feeding in a marsh away from the nest. The bird runs for several yards, taking huge steps and flapping its outstretched wings as if about to take off, then runs back to the other bird, stopping short a few feet away. The saddlebill and blacknecked storks are solitary nesters and both species probably mate for life. Neither associates closely with any species other than its own, and they also share a feeding behavior featuring a slow walk while probing the water for food. Since these storks are alike in so many important respects, both morphologically and behaviorally, I recommend that they be combined into one genus, *Ephippiorhynchus.* (The jabiru stork cannot be included because of other basic differences from the saddlebill and blacknecked storks.)

Other examples of similar behavioral relationships are now known, and further illustrate the importance of field studies of behavior, which, when combined with our knowledge of the bird's morphology, give us a much better understanding of how present-day storks are related and how they evolved.

White storks perform a spectacular up-down display to exchan
greetings at the nest. The birds arch their necks until their crow
rest on the feathers of their backs. A prolonged series
bill clatterings accompanies this behavi

SALT

when
it rains
it pours ®

by Raymond C. Murray

The great mineral deposits of the world formed in many ways. Some were produced from hot-water solutions moving through underground rocks, others from masses of molten rock deep within the earth. The fossil fuels owe their existence to accumulations of ancient life. Salt, which has a greater impact on our lives than perhaps any other single mineral resource, was produced directly from seawater.

Man's dependence on salt has influenced his migrations and conquests since prehistoric times.

In the United States, we use in excess of 85 million tons of salt each year to satisfy our physiological needs and to supply a vast chemical industry.

Salt, or sodium chloride, exists dissolved in the seas, which cover three-fourths of the globe, as well as in the form of the mineral halite within sedimentary rocks. Minor amounts are dissolved in groundwater deep beneath the surface of the earth, within sediments beneath the oceans, and in salt lakes such as the Dead Sea and Great Salt Lake. Oceanic water generally contains about 3 percent sodium chloride. If all the dissolved salt were removed from the sea, it would produce a mountain with a volume of about 4½ million cubic miles. Such a mountain would be half again as large as all of North America standing above sea level.

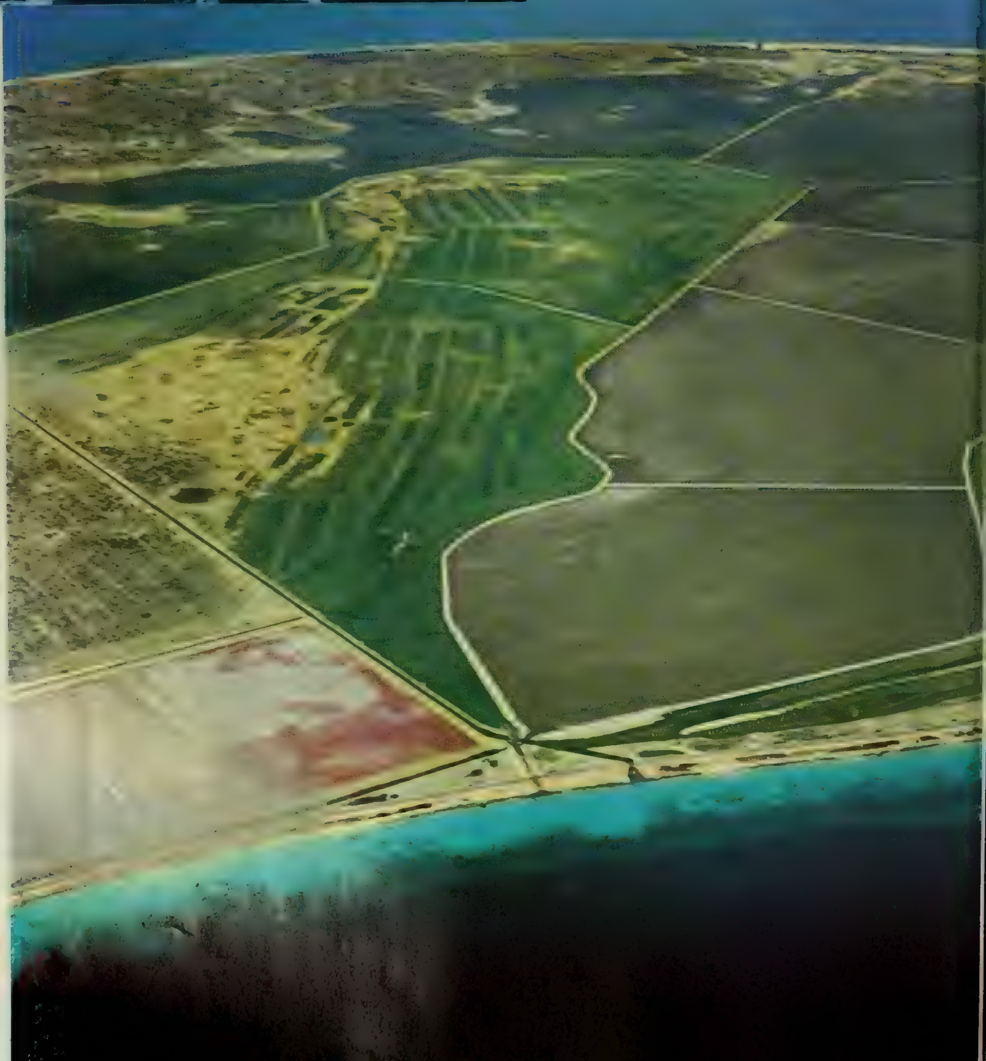
The salt in the sea dates back to the very beginning of the oceans. Water was derived originally from volcanic gases, and this source has continually added new water to the earth since the beginning of the planet. Volcanoes emit many gases, the most abundant being water vapor. Condensation of this vapor supplies the liquid water to the seas. Much of the chlorine found in the sea also came from volcanic gas, while the sodium was derived from the weathering of rocks on the land. Weathering processes liberate sodium from minerals, and the sodium is then transported in solution by rivers to the ocean. Ancient, salt-containing rocks are constantly being weathered, thus returning the salt to the sea from which it was originally derived.

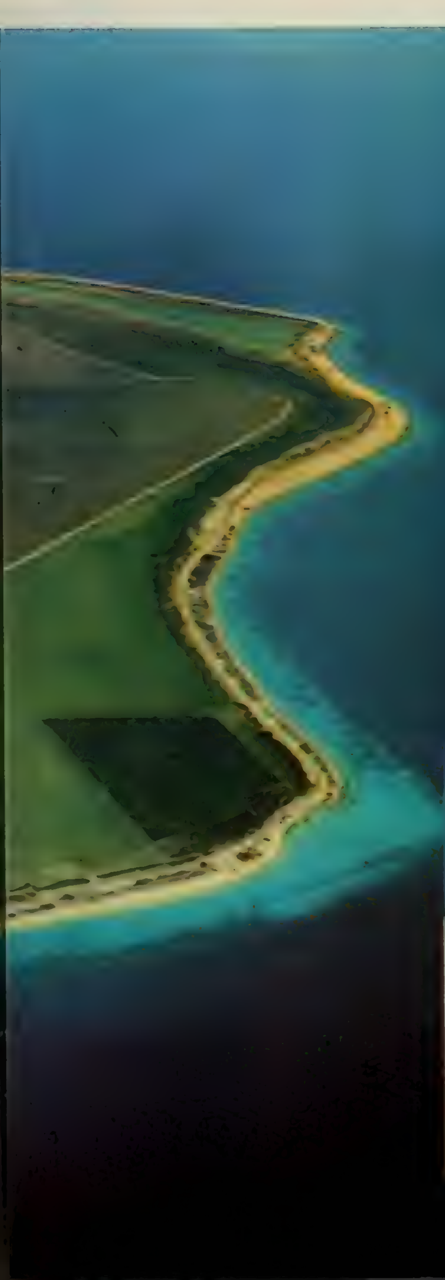
Seawater contains other dissolved materials, such as calcium, sulfate, magnesium, potassium, and bicarbonate. In fact, more than half the elements that exist on earth can be found in seawater. These other dissolved solids make up approximately one-half of one percent of the water in the oceans.

Rock salt, the mineral halite, is precipitated when seawater is concentrated by evaporation. Usiglio, a chemist working in Sète, France, recognized and studied this process in detail in 1849. He wanted to know how much evaporation had to take place in seawater to precipitate halite and at what stage in the evaporation process gypsum (hydrated calcium sulfate) and the magnesium and potassium minerals would precipitate.

Usiglio found that gypsum precipitated from the water after it had been evaporated to approximately one-third of its original volume. With continued evaporation to one-tenth of the origina volume, halite started precipitating Continued evaporation to less than 1/20 of the original volume caused magnesium and potassium minerals to form. Later investigators have described the complex minerals and the changes in minerals that take place in concentrated brines.

Gypsum begins to precipitate when seawater has evaporated to about one





A modern solar saltworks on Bonaire in the Netherlands Antilles is a mosaic of shallow ponds covering 5,000 acres. Seawater comes in on the far shore, and goes through ten condenser ponds (the light green and brown ponds at center and right). Then it is pumped into the crystallizing ponds (square, pinkish ponds at lower left). Pumps return the remaining brine to the sea (lower left). The square section in the fifth brown pond from the bottom is a flamingo breeding area; the dark square at the lower right corner of the island is a 300-year-old solar salt plant. In the upper left photograph, brine is pumped into a pond; at lower right, the salt is harvested. Both small pictures are from Long Island in the Bahamas.

third of its original volume and continues to be deposited as halite begins to precipitate at one-tenth of seawater's original volume. Similarly, halite and some gypsum continue to precipitate at higher concentrations when magnesium salts start forming. This means that during evaporation and concentration of seawater beyond one-tenth of its original volume, more than one mineral is always forming. Yet geologists have long observed the existence of thick beds of relatively pure rock salt that must have been formed by evaporation of ancient seas. This contradicts the chemical data in two ways:

1. The ancient salt deposits are too thick to have been deposited from the evaporation of a sea of any imaginable depth. For example, the total evaporation of a sea 1,000 feet deep would produce less than 14 feet of salt. Yet beds of salt hundreds of feet thick are common.

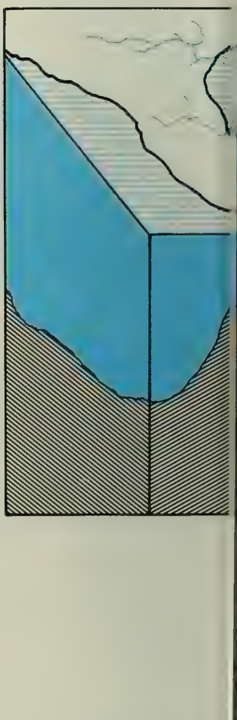
2. These ancient thick beds of salt are too pure, in that they do not contain an abundance of other minerals. Evaporation of seawater should also produce other minerals, such as gypsum and the magnesium and potassium salts.

There is only one special set of conditions that will resolve this apparent contradiction. It was first suggested in 1947 by R. H. King, a geologist working with the vast 250-million-year-old salt deposits in west Texas and New Mexico. King reasoned that if a body of seawater could be concentrated by evaporation to slightly more than one-tenth of its original volume and maintained at that concentration, then halite with minor amounts of gypsum would be precipitated. Because the concentration would be maintained, the brine would never reach the point of precipitating the magnesium and potassium salts.

This can be accomplished by continually supplying new seawater to the body of water being evaporated, while at the same time withdrawing brine from that body so that the concentration remains the same. A part of the sea must be almost isolated from the main body of the ocean so that evaporation and concentration can proceed; new seawater must be able to enter in limited amounts to replace the water lost by evaporation. The new seawater can enter through a small surface connection or through underground seawater springs. It is difficult to appreciate the delicate balance between isolation and limited availability of new seawater and, geologically, it must be very rare. For example, the Red Sea and its two smaller gulfs, Aqaba and Suez, are connected to the Indian Ocean by relatively small channels. Despite the high rate of evaporation in the area today, however, these bodies of water are not sufficiently isolated from the Indian Ocean to raise significantly the salinity of the water within the Red Sea and its gulfs. Exchange of water is simply too easy between the Red Sea and the Indian Ocean.

The second requirement needed to maintain a body of water at a concentration just above that needed to precipitate halite is that heavy brine must be withdrawn continually. When a pan of seawater is evaporated in the laboratory and new seawater is added continually to replace that lost by evaporation, the concentration will continue to rise, and magnesium and potassium salts will soon precipitate. If, however, there is a small hole in the bottom of the pan that allows just enough concentrated brine to leave while new seawater is being added, then the concentration of the brine in the pan will stay the same.

Two ways by which the brine can be removed in nature have been suggested. Both are called *reflux*. In the first, the surface channel that connects the isolated sea permits new, lighter seawater to float into the evaporating area while the denser, concentrated brine from the evaporating sea flows out underneath and back to the sea.



This block diagram, with both a top view and cross section, shows a hypothetical salt bed being formed. The critical requirement is restricted ingress for sea water and balanced egress for the brine over long periods of time.

**In a man-made saltw
seawater flows thr
a series of shallow p
Different mineral
precipitated in diff
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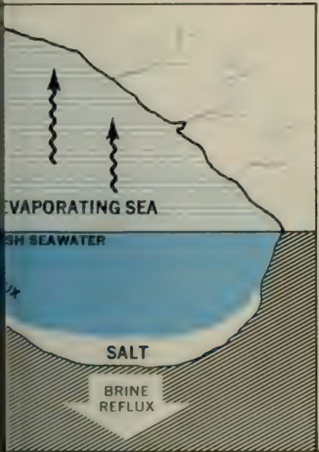
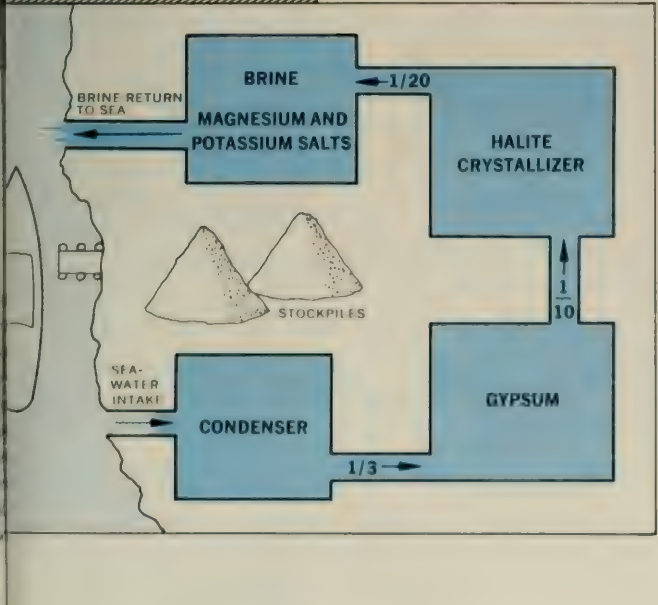
In the second case, the brine, which is denser than the water within the sediments and rocks on the bottom of the sea, sinks down into the underlying rocks and sediments, displacing the original lighter water. We have all observed such a process when a glass of crushed ice (porous sediment) is partially filled with a light fluid such as alcohol. When a denser fluid, such as water, is added to the glass, it will tend to sink down in tongues, displacing the lighter fluid upward. This process continues until the lighter fluid is on the top or until the fluids are mixed so that no contrast in density exists.





This process of constantly replacing the water lost by evaporation with fresh seawater accounts for the thick deposits of salt found in nature. These deposits are far thicker than those that would be produced by simple evaporation of a single body of water. The actual amount of seawater evaporated represents many, many times the volume of the original body of water.

No natural body of water on earth today achieves the delicate balance of restriction with a limited supply of new seawater and loss of brine by reflux that would permit the accumulation of relatively pure salt. The thick, pure beds of rock salt in the geologic record, however, tell us that it has happened many times in the geologic past. Much of the salt produced today is mined from beds that formed in the geologic past. Such beds are being actively exploited in the United States in such diverse areas as Michigan, New York, Ohio, New Mexico, Kansas, Texas, Louisiana, and several other locations. Throughout the rest of the world, ancient salt is mined in major amounts in South America, Europe, Africa, Asia, and Australia.

Despite vast reserves of ancient salt, approximately 30 percent of our salt today comes from man-made solar saltworks, and it appears that this proportion is increasing at such a rate that it will soon become the major source. In earliest times, man learned that if he built a dike around a small, shallow part of the sea in an arid climate, the water would evaporate and a layer of salt would form. The salt accumulated on the bottom of the isolated pond and was then available for harvesting and use. It is still done that way today.

A spectacular example is the saltworks on Bonaire in the Netherlands Antilles. Beginning in the seventeenth century, the early settlers on this Caribbean island built dikes of stone and sand that isolated a series of ponds on the low-lying flats adjacent to the sea. New seawater was permitted to flow into the ponds to replace water lost by evaporation. The brine in the ponds, however, did not become sufficiently concentrated to precipitate salt. Somehow, evaporation was taking place and new seawater was being added, but the brine never reached a concentration beyond that needed to precipitate gypsum. The problem again was reflux, although these early saltmakers probably did not know the word. Some places beneath the walled-off salt ponds were highly permeable, that is, they permitted the slightly concentrated, slightly heavier brine to escape down into the underlying rocks. As soon as the brine in the pans built up to a concentration approximately four times that of the original seawater, the brine tended to sink down; thus the water never achieved the concentration necessary to produce salt. In addition, these permeable areas acted as springs that poured too much fresh seawater into the pans, thereby helping to dilute the water being concentrated by evaporation.

The early would-be saltmakers recognized the problem probably because they observed the seepage of fresh seawater from springs in the bottom of the pans. The solution was simple. They built small walls of rock and sand around each of the springs to isolate the permeable areas, thus restricting the inflow of too much fresh seawater and the outflow of too much brine. As a result, salt started to form. By allowing just enough seawater to enter and by plugging enough of the places where concentrated brine could escape by reflux, they achieved the delicate balance that nature achieved in many ancient rock salt deposits. The rate of evaporation was matched with the introduction of just the right amount of new seawater balanced by just the right amount of heavy brine removed by reflux, water as the pans established and maintained a concentration slightly greater than that needed to precipitate salt. Thus salt, with a minimum of impurities such as gypsum and with no magnesium or potassium salts, was produced. The need for salt on an island surrounded by saltwater was met and fish could be preserved for later eating.

Present-day solar saltmakers use much the same system, but engineer their operation to eliminate some of the difficulties imposed by nature while still taking advantage of nature. The first requirement is a climate where net evaporation exceeds net precipitation. The greater the excess evaporation, the more productive the operation; that is, more salt will be produced. The second requirement is a low-lying coastal area, where salt ponds with an available supply of fresh seawater can be built. Solar saltworks have been built along the western coast of the United States, the Caribbean, the western and eastern coast of South America, the east and west coasts of the southern part of Africa, the shores of the Mediterranean, and the southern coasts of Asia and Australia.

Once the dikes are built and many ponds with connecting channels are formed, fresh seawater is either pumped or allowed to flow into the first lake. When the seawater becomes slightly concentrated by solar evaporation, it is permitted to flow on to the next shallow pond. In this way much of the gypsum is precipitated in shallow lakes, called condensers, before the brine becomes concentrated to approximately one-tenth of its original volume. When the brine reaches the concentration necessary to precipitate halite, it is allowed to flow into ponds called crystallizers. In the crystallizers, halite, with minor amounts of gypsum, is precipitated and settles to the bottom. The brine is then led off to other lakes before it becomes sufficiently concentrated for the magnesium and potassium salts to form.

In such an operation, the sediment and rock underlying the lakes must be nearly impermeable. If they are not, then brine will be lost by reflux and the energy of the sun used to evaporate the brine up to that point will have been wasted, making the operation very inefficient. Because no reflux is permitted, the highly concentrated brine must be removed by surface channels into nearby ponds and ultimately back to the sea. When a solar salt operation is running, the concentration of the brine gradually increases as the water flows from its entry point, through the evaporating pools, to the point where the final brine is discarded. In each pool the concentration remains constant.

In many natural deposits of ancient salts the rate of evaporation must have been very high, the source of fresh seawater very limited, and the rate of reflux very low. Under these conditions the magnesium and potassium minerals precipitated.

Both these minerals are produced today by miners working underground mines and by solution mining, in which dissolved minerals flow to the surface in pipes. Much of the potassium used in fertilizer comes from these sources. In solar saltworks, where reflux is kept at a minimum and addition of fresh seawater is restricted by gates and valves, only the evaporation rate at a given point determines whether the final brine will be used or returned to the sea. If the evaporation rate is high, it may be economically possible to precipitate the magnesium and potassium minerals in ponds separate from those that produce halite and supply them to the mineral market.

In all solar saltworks, the salt is harvested by stopping the operation and removing the accumulated salt with plows and bulldozers. The product will contain some gypsum and some liquid brine between the salt grains. This liquid brine must be removed, because if it is allowed to evaporate, then some magnesium and potassium compounds will be precipitated within the salt during storage. Removal of the liquid brine is normally accomplished by allowing the salt to drain while standing in a pile, or the salt may be passed through a centrifuge to remove the brine. Washing with fresh water or simply allowing a few days of rain to fall on the pile of harvested salt will remove most of the impurities. A final product with less than 0.0025 percent magnesium is not uncommon, with the only significant impurity being approximately 0.2 to 0.4 percent gypsum. Such a product is ready for delivery to our table saltshakers.

Thus, both man and nature make huge amounts of relatively pure salt using the energy of the sun. In both cases the requirements are the same—a high evaporation rate, isolation from the main body of the sea, a constant source of fresh seawater in limited amounts, and the proper amount of loss of concentrated brine to maintain a near constant concentration of the salt-precipitating brine.

The production of salt is one of the few instances where man has been able to compete effectively with nature in forming mineral deposits. To understand ancient rocks and how they were

Salt arches from a slinger at the end of a conveyor belt to a stockpile. The salt is produced in evaporation ponds near Utah's Great Salt Lake.

formed, geologists normally use the principle, first stated by James Hutton in 1795, of "uniformitarianism," sometimes given as "the present is the key to the past." To do this, they study processes that are making sediments and rocks today and assume, usually correctly, that the same processes created the ancient rocks. For example, modern volcanoes are studied so that we will be able to understand ancient volcanic rocks; rivers are studied so that we will be able to recognize ancient sandstones that were deposited in them. In many ways, modern, man-made solar saltworks use the principle in reverse. We have learned from ancient salt deposits how to deposit salt. Understanding of ancient salt has been enhanced, however, by observing the workings of modern solar salt operations combined with chemical studies of seawater.

Man's use of salt and salt deposits will expand as we learn more, and as the technology develops for using the information. For example, in the production of fresh drinking water by desalinization of seawater, the operation is designed to produce and collect the removed fresh water instead of the salt. A natural by-product of desalinization is salt. It has been estimated that a 50-million-gallon-per-day desalinization plant could produce 10 percent of our annual requirements for rock salt, in addition to 30 percent of our magnesium and 1.8 percent of our potassium needs. When, in the future, this source will become significant will depend on the economics of the whole salt production and mining industry. Until that time, the concentrated brine that results from desalinization will present tremendous disposal problems.

When salt is removed from mines developed in ancient salt beds, the mines themselves present possibilities for use. Rock salt has several significant properties. In the natural rock, it is virtually impermeable, allowing the passage of almost no water. Thus salt mines are almost always dry. This makes abandoned mines ideal for the storage of documents or as containers for gases under high pressure, such as liquid petroleum gas. In addition, natural rock salt has a relatively high thermal conductivity, permitting heat to be dissipated more rapidly than in most other rocks. For this reason, abandoned salt mines have been suggested and tested as places to store high-level radioactive wastes. The potential uses of abandoned salt mines in all types of environmental planning have only recently begun to be explored.

Without salt, both ancient and that produced by man, we would face many problems in industry and health, and we would miss the promise of opportunities for the future.

Sky Reporter

The Satellites of Saturn At least five of Saturn's ten moons are visible in small telescopes (those with an objective of three or four inches); the largest, Titan, is as big as the planet Mercury and should just be visible as an eighth-magnitude star in large binoculars. This is the best time this year to observe Saturn and its moons as it comes within 750 million miles of the earth. Moving through the constellation Taurus, Saturn will reach magnitude –0.2 at opposition on November 25.

In order of brightness after Titan are the smaller moons Rhea, Tethys, Dione, and Iapetus. The others are too faint for moderate instruments. One of them, Janus, moves so close to the rings that it was not discovered until 1966.

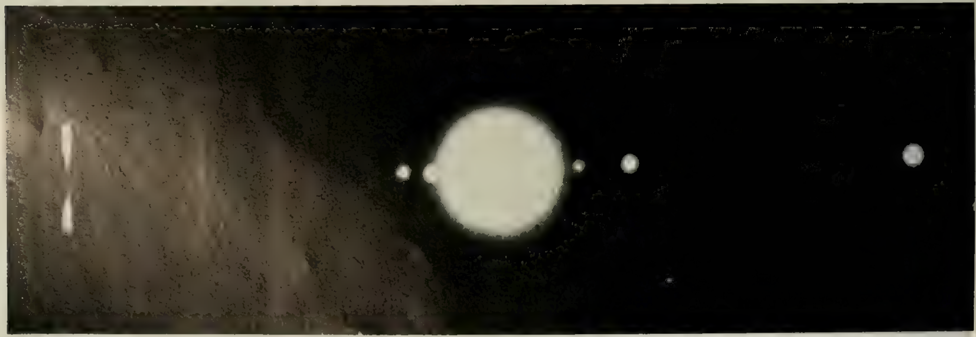
The five brighter moons present challenges all their own. The best known question is, why is Iapetus five times brighter when it is going away from us than when it is coming toward us? Only Titan shows a disk at all, so studies of the moons are confined to analyses of the light they reflect. That does not sound like much, but a recent paper in the *Astrophysical Journal* by three MIT researchers shows how much can be done with so little incoming information.

The spectra they obtained at ultraviolet, visible, and infrared wavelengths are quite different from spectra of the moon, Mars, or the four bright moons of Jupiter. More surprisingly, they are quite different from spectra of what might be called the eleventh satellite of Saturn, the rings themselves. The spectrum of Titan is again different from the other four, but there are similarities between it and the spectra of the colored belts on the bodies of Saturn and Jupiter, suggesting that whatever causes the color in the planetary bands is present on Titan as well.

Three of the five satellites are 10 percent brighter when they are coming around from behind Saturn toward the earth than when they are receding. Titan shows no changes. Iapetus reverses the trend of the first three by becoming five times brighter when receding. It also becomes considerably less red.

The light curve proves that Iapetus is locked into synchronous rotation around its planet as our moon is around the earth; it always shows the same face to an observer on the planet. The face we see when Iapetus is approaching us, always the same, is the leading edge. Its relative darkness could be accounted for, the MIT investigators feel, by meteorite bombardment of a frost cover: darker, redder surface material would be uncovered. The trailing edge we see when Iapetus is receding would not be as subject to meteorite falls, and thus the surface frost would be relatively undisturbed.

(For the same reason, we on earth see more meteors after midnight than we do earlier. After midnight, our position on earth is on the side facing the direction in which the earth is moving; meteors moving in any direction are swept up. Before midnight, only meteors that are going in the right direc-



Saturn and five of her moons in a photo taken December 21, 1966. From left: Tethys, Dione, Saturn, Enceladus, Rhea, and Titan.

ion and are fast enough to catch the earth can be seen.)

But Rhea, Dione, and Tethys also show the presence of e in their spectra and yet exhibit only a very small change n brightness from one side of their orbit to the other. Per-aps the ice is thicker, and the meteorites do not reach the nderlying surface. Titan is a separate case; it appears to ave an atmosphere, with methane a major constituent. hus most meteors striking Titan would not reach the sur-ace. But most of the questions are yet to be answered.

ival to the Crab The Crab Nebula in Taurus is justly amed for its central role in the development of astrophysics see "Dissecting the Crab," October, 1970). But it is not the nly object in the sky that combines a nebula, the remains f a supernova explosion, an extended X-ray source, and a ulsar.

Far down in the southern sky, centered on the con-tellations Vela and Puppis, lies a nebula that extends over a emarkably large portion of the sky. Named for its Austra-ian discoverer, the Gum Nebula covers an area of as much s 30 by 40 degrees (45 degrees is the distance from the oint overhead halfway to the horizon). It is a radio and X-ay source, apparently a lingering effect of a supernova ex-losion that occurred about 11,000 years ago. A pulsar left y the explosion has one of the shortest known periods (the rab pulsar has the shortest), indicating it is among the oungest.

Best of all, it is no more than a quarter as distant as the rab Nebula. The center of the nebula lies no more than 1,500 light-years away. Its edge may be as close as 200 ght-years. The center of the Crab Nebula is some 6,000 or nore light-years distant.

When the supernova exploded, its radiation excited clouds f hydrogen in interstellar space so that they glowed. Even hough the explosion took place 11,000 years ago, the louds are still glowing, and two very hot stars near the cen-er help keep them shining.

A sphere of excited, glowing gas around a hot star is alled a Strömgren sphere, for the man who described the henomenon. Four scientists at the Goddard Space Flight enter, writing in the *Astrophysical Journal*, propose that he Gum Nebula be considered a "fossil Strömgren sphere," s the gas was excited by something that no longer exists.

John C. Brandt, Theodore P. Stecher, David L. Crawford, and Stephen P. Maran also suggest that because the supernova was so close, relatively speaking, from the earth it must have appeared as bright as a quarter moon, and there could be human records of it. They note that the supernova of 1054, which produced the Crab Nebula, was recorded by American Indians, as well as by Chinese and Japanese astronomers. They also point out that the 11,000-year age ascribed to the Gum supernova is only an estimate; its true age could be considerably less. Any record would almost certainly be found in the Southern Hemisphere; the Vela-Puppis area of the sky is not visible from most of the northern half of the earth.

Are there any other fossil Strömgren spheres in the sky? Bart J. Bok of Arizona's Steward Observatory, reporting on a Gum Nebula symposium in *Sky & Telescope*, mentions two candidates in the northern sky, one near a supernova remnant in Cygnus, the other on the boundary of Cassiopeia and Cepheus.

A New Kind of Pulsar X-ray astronomers, working with observations made from a satellite, have found a star that appears to have collapsed into a neutron star or black hole without having gone through a supernova explosion.

The star is Cygnus X-1, a well-known X-ray star. A group at American Science and Engineering, Inc., has now found that the X-rays are pulsed in a period almost as short as the Crab Nebula pulsar. The rapid changes in X-ray emissions mean the star must be a rapidly rotating collapsed object. But it emits no detectable radiation at radio wavelengths, as do all supernova remnants. Attempts to detect radio signals have been able to determine only that any radio emissions must be 1,000 to 10,000 times weaker than those from the Crab. The lack of radio emissions makes Cygnus X-1 unique among pulsars.

The seven-man research team says in *Astrophysical Journal* (Letters) that their findings leave them with the question of whether a collapsed star can be formed without a supernova explosion or whether unusual circumstances can avoid production of the usual tremendous radio output following such an explosion. In the meantime they have come up with the first strictly X-ray pulsar.

JOHN P. WILEY, JR.

Celestial Events

The moon is in the evening sky in late October, with new moon on the 19th and first-quarter on the 27th. In early November, full moon is on the 2nd, and the moon then moves into the morning sky. Last-quarter occurs on November 9 and new moon on November 17.

All five of the visible planets are in the evening sky in late October and early November, but not all are easily seen. Mars continues to be the most prominent, very bright in the south at dusk, among the stars of Aquarius, and setting at about midnight. Venus and Jupiter are both low in the southwest in evening twilight, visible for about an hour before setting. Venus is the brighter of the two, to the west (right) until the 11th, thereafter to the east (left). Saturn rises in the early evening among the stars of Taurus and is visible until dawn. Mercury is a rather poor evening star, as it approaches eastern elongation in November.

October 20: The very slim crescent moon, only thirty-six hours old, is in conjunction with Venus. If you haven't yet found the planet in the evening sky, look just above the moon this evening. The other bright planet, well to the left and above the moon, is Jupiter.

October 21: Maximum of the Orionid meteor shower occurs today, with no moonlight to interfere with after-midnight observations. The usually fast, bright meteors of this shower are observed at a rate of about 25 per hour at maximum, less than half that rate a day before or after maximum.

October 22: Tonight's crescent moon, three and a half days old, is much easier to find, in the southwest at dusk. The bright planet directly above the moon is Jupiter. Well to the right, brighter, and below Jupiter is Venus. And quite close to the crescent moon, just barely below it, is Antares, the brightest star in Scorpius. The moon occults Antares this evening in skies over South America.

October 29: The bright red planet Mars is found easily tonight by looking just below the moon, only hours past first-quarter, in the early evening sky.

October 30: Jupiter and Antares are finally in conjunction, the first time this year. The planet has been quite close to Antares, approaching the bright red star in early spring, backing off as the planet went through its retrograde motion in spring and early summer, approaching Antares again in late summer and fall.

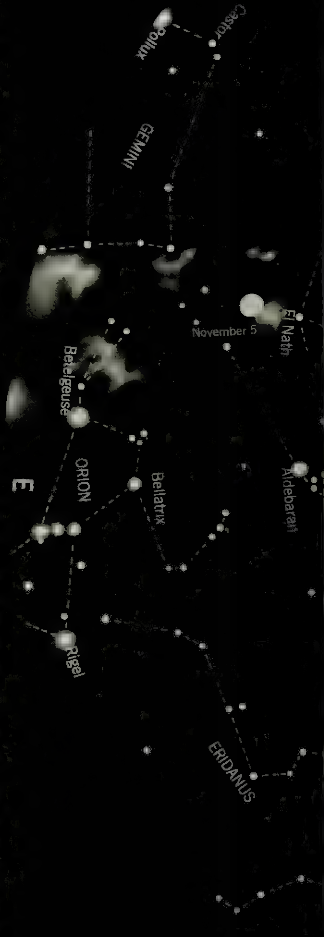
November 4: Saturn is close to the gibbous moon this evening, rising to the right of the moon early at night, setting below it after dawn tomorrow morning.

November 5: The bright gibbous moon will make it difficult to see meteors from the weak and faint Taurid shower, at maximum today.

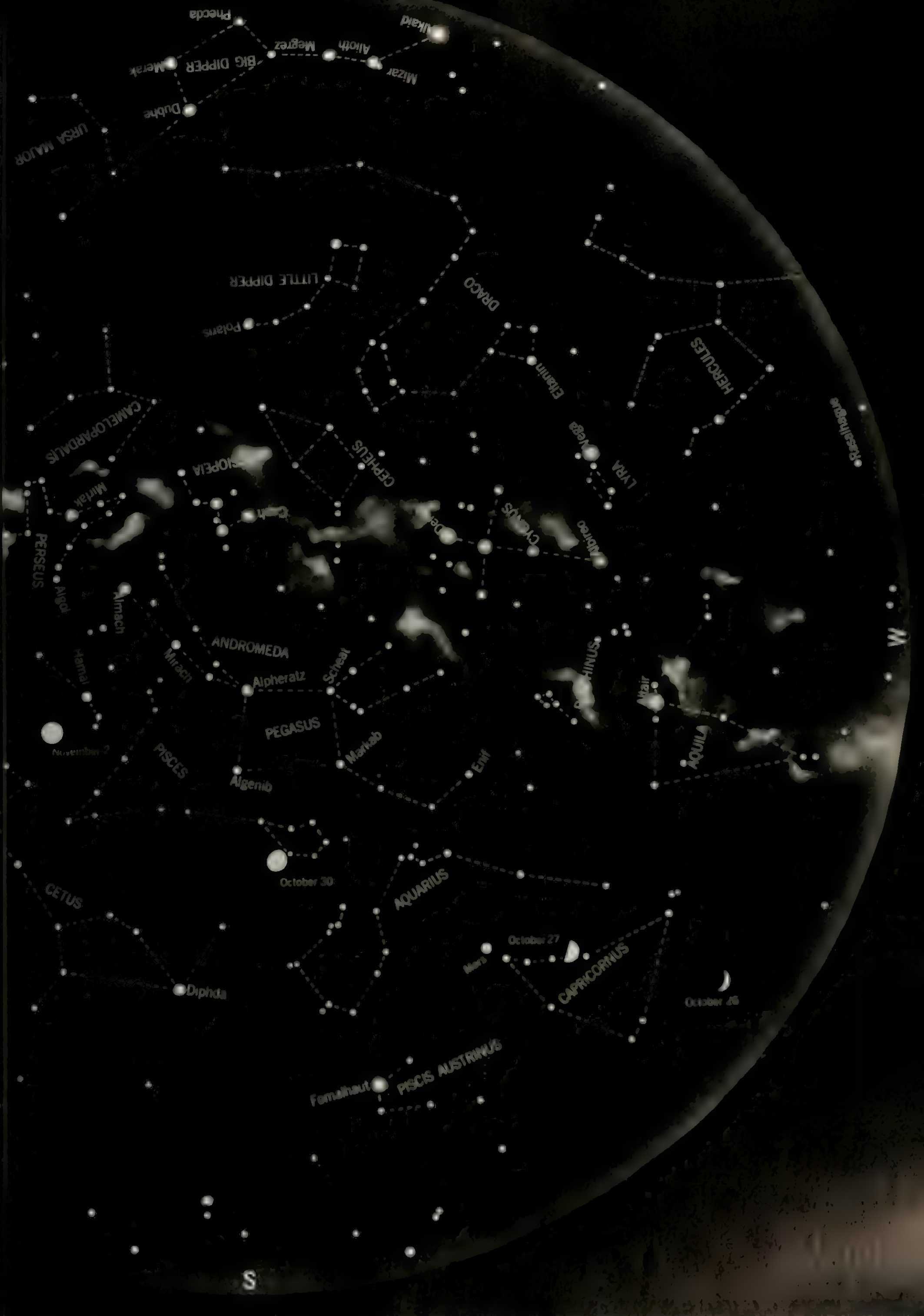
November 11: Venus, still very low in the southwestern sky during early evening, passes Antares in Scorpius. Antares is below and to the right of Venus; Jupiter is just to the left of Venus.

November 14: With the aid of binoculars, you may be able to see an interesting arrangement of planets this evening. About 30 or 40 minutes past sunset, look into the west, just to the left of where the sun went down, and along or slightly above the horizon. Mercury, Venus, and Jupiter are all there, quite close together. Venus is brightest; Jupiter is second brightest and just above Venus. Mercury is much dimmer, about six lunar diameters below and to the right of Jupiter.

THOMAS D. NICHOLSON



★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:20 P.M. on October 15; 9:20 P.M. on October 31; and 8:20 P.M. on November 15; but it can be used for about an hour before and after those times.


Phecda
Alkaid
Megrez
Alioth
Mizar
BIG DIPPER
Merak
Dubhe
URSA MAJOR
LITTLE DIPPER
Polaris
DRACO
HERCULES
Rasalhague
Eltanin
Vega
LYRA
CAMELOPARDALIS
SIOPEIA
Caph
Mirfak
CEPHEUS
De
CYGNUS
Albireo
PERSEUS
Algol
Almach
ANDROMEDA
Hamal
Mirach
Alpheratz
Scheat
HINUS
Altair
W
November 2
PEGASUS
PISCES
Markab
Enif
AQUILA
Algenib
October 30
CETUS
AQUARIUS
October 27
Mars
CAPRICORNUS
October 28
Diphda
Fomalhaut
PISCIS AUSTRINUS
S

The Life and Times of SHAG

The stray dog in an urban world lives by the same principles of food chains, territories, and predator-prey relationships as animals in the wild

by Alan M. Beck

It was still dark enough to see stars when I arrived at the Amalgamated Clothing Workers of America (ACWA) building near downtown Baltimore. I saw and heard nothing. I left the car, walked around the building, returned, checked the air temperature, and reported my findings into a tape recorder I always kept with me:

2 September 1970, 64° F., clear and slightly windy, 4:20 A.M. No signs, garbage behind homesite from previous day now gone—probably collected. I will now wait for Shag, who I suspect is still in the shrubbery, left side of ACWA, Eutaw and McMechen.

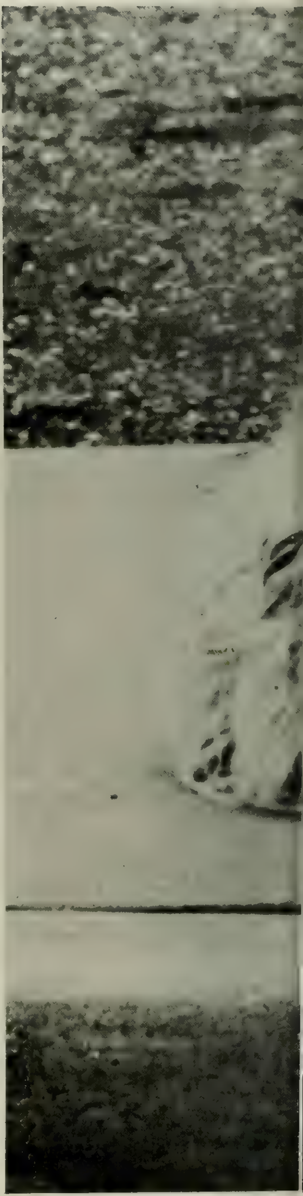
Studying the stray dogs of Baltimore is my thesis project for a doctorate in ecology, and for the next few weeks I would be concentrating on Shag, a large, white, shaggy-haired male with black markings. I chose him from the study population because he was a truly ownerless stray. Ordinarily, owned and ownerless strays are indistinguishable, except at moments of owner–dog interaction, and both types serve as the feral dogs of the city environment.

Lately, Shag had been spending his nights in the shrubbery, although earlier in the summer, he had found shelter in a house hallway. He would push the front door open to gain access and wait for someone leaving to help him get back to the streets, but his habit of "marking" the inside hall had led to his ouster by the building's residents. During the past two years, I discovered other stray dog den sites—in vacant buildings and garages, under porches and cars, and in garbage dumps. All provide protection against weather and people.

4:50 A.M. Barking now becoming apparent. The area is coming alive, but still no sign of Shag.

Waiting is a very real part of wildlife study. I welcome it, however, as it gives me time to plan future approaches and reflect on aspects just completed. I spent the first part of the summer of 1970 sampling the dog populations of selected areas around the city, mainly by photographing each stray dog and plotting the sighting on maps. One advantage of working in the urban ecosystem is the ability to locate the subject with remarkable precision by using street crossings and house numbers.

Another advantage of studying feral dogs is that their mixed heritage leads to wide variations in morphology and behavior, which enabled me to recognize individuals. I seldom encountered the monotony of pedigree breeds. As part of my studies, I photographed every stray dog I saw while traveling through a neighborhood. A dog photographed more than once is, in the terms of wildlife study, a recapture. Therefore, just as a wild bird population can be calculated from the number of banded birds recaptured, I was able to compute the city's stray dog population from the number of dogs rephotographed. Photographic recapture and other methods revealed a total population of 100,000 dogs, both owned and ownerless, in Baltimore, which is an in-



Feral Dog in Baltimore

Three feral pups, of a litter of four born beneath the porch of an abandoned house, venture into an alley. They quickly learned to scavenge food around garbage cans. But like other wild creatures, these young suffered a high mortality. Within a month, two of the pups were killed by cars, and a third was stoned to death by children.

crease of 25,000 animals over the city's dog population as estimated ten years ago by Dr. Kenneth Crawford, the state veterinarian.

Cities throughout the world are encountering such dog population explosions, including the half-million dogs each in New York, Mexico City, and Buenos Aires. In many cities, dogs appear to be increasing more rapidly than humans. Such populations have many ecological implications for a city. A study by New York's Environmental Protection Administration noted that the owners of dogs permit them to leave from 5,000 to 20,000 tons of excrement and from 600,000 to over a million gallons of urine on the streets each year. Even if Baltimore has only one-fifth of those estimates, what does it mean for this or any city? While my original objective was to establish the life history of the feral urban dog, I had to include such implications, for they are part of the ecology of the animal.

Ever growing fecal depositions are a potential health hazard as well as an insult to the senses. There is the possibility of visceral larva migrans (VLM), a syndrome caused in humans when the eggs of *Toxocara canis* (dog worms) are ingested, usually by children playing in or eating infected dirt, often from under street trees where dogs may have defecated days earlier. Severe cases of VLM, characterized by enlargement of the liver and spleen, convulsions, and blindness, are very rare. One symptom, which often goes undetected, is a marked increase in the number of eosinophil cells in the blood. Milder symptoms, such as coughing and fever, are so like other childhood diseases that VLM goes undiagnosed most of the time. Although there have been six child blindness cases reported at Baltimore's Johns Hopkins Hospital in the past ten years, there has been no record of VLM frequency in its less debilitating form.

Dog feces is a major factor in th breeding of houseflies, which then possibly transmit such bacteria as *Salmonella* from dogs to man. In addition, ra

radication officials and residents of my
udy area have observed rats feeding
n dog feces and, indeed, rats are most
ommon in alleys with high fecal resi-
ues. Garbage, from cans knocked over
dogs, and dog feces are probably im-
ortant components of the rat food
hain.

At 5:22 a collie bolts out of an open
oorway, which is then closed. Other
ogs are now apparent, but still no
gn of Shag.

This kind of pet release, before and
fter the usual work day, is one reason
hy dog activity is greatest in the morn-
ngs and evenings. Ownerless strays are
lso active during these periods, possi-
ly because dogs are gregarious ani-
nals, imitating each other's activity, or
ecause all dogs avoid activity during
he heat of the day.

6:00 A.M. The sky is light blue and
hurch bells are ringing. Shag and a
ale doberman, Shag's constant com-
anion, appear in the rear view mirror.
here in the hell did they come from?

Waiting was over, and I left the car to follow at a distance with tape recorder and camera. Because feral urban dogs are accustomed to the presence of man, their normal activities may be studied more easily than those of most wild animals. If the dogs gave any indication that I was altering their behavior by following them, I turned away or "tied" my shoelace, which was all that was necessary for them to lose interest in me. Anyone observing my behavior must have assumed that I was an unemployed photographer with particularly obstinate shoelaces.

Shag and Dobe headed for their usual feeding alley, where they were joined by several other dogs in going from garbage can to garbage can, sniffing and occasionally lifting off bags from the tops. Some of the cans had already been knocked over. It was 6:09 and still dark enough to observe rat activity. Dogs, cats, and rats all seemed to ignore each other, sometimes eating garbage within a foot of each other. But my presence chased away the rats. Garbage collection was on Mondays and Thursdays. As this was Wednesday, there was ample food. But even after collection on the following day, there would be enough residue left on the

Garbage is a major source of food for feral dogs. The bigger dogs often knock over refuse cans, and then both large and small dogs in a pack can get food. Rats and cats benefit, too, from the littering. On several nights, dogs, rats, and feral cats were all seen feeding on garbage only a few feet from each other.

Shag and his packmate, Dobe, regularly stopped and waited patiently in front of a Baltimore building. A lady opened the window, whistled, and threw some food to the pair, aiming a special tidbit in Shag's direction. Handouts from humans are an important food source for urban feral dogs.

ground to attract dogs before the street sweepers removed it, so garbage collection day was not an environmental catastrophe. The residue persists to the evening and undoubtedly feeds the nocturnal rats, mice, and roaches. Subtle changes in canine presence and behavior do occur with food availability, so dogs can be used as indicators of urban environmental deterioration and can be correlated with trash and pest species.

By 6:20 Shag and Dobe returned to the alley beside the ACWA building, where, as usual, they found water under the air conditioner unit. They lay down in the median green, facing east. It is 59° F. At 6:34 Dobe rose and left.

This was my day to be with Shag so I waited, watching him as he slept. Five minutes later he stood, stretched looked and sniffed in all directions then immediately took off in the sam direction as Dobe had. They were a tru pack of two.

One-half of the dogs I observed wer in the company of other dogs (as man as 17 in one pack), but few packs ar stable in size and membership. Instea the packs form and dissolve over a pe riod of minutes or hours, giving the im pression of a loose social structure more like that of people in the street than wolves in the wild.

I followed Shag through several a leys, and at 6:45 we caught up wit Dobe, who was feeding at the base of a overflowing apartment house dumpste Children, unable to open its heavy doo had left garbage bags at the base. Th dogs left to continue their tour of the a leys and streets. Being large dogs the could often lift bags of garbage out the cans without knocking them ove They would rip open paper and plasti bags by shaking them or running wit them in their teeth. I am not sur whether they could smell the foo through the plastic bags or had learne what they contained from previous en counters with open plastic bags.

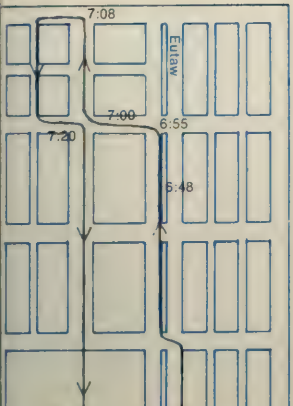
At 7:00 A.M., the dogs are bac on Madison and meet two small pe dogs that have just emerged from doorway. Shag attempts a typic nose–anus greeting but is rebuffed b barks and snaps. No fight. Shag an Dobe cut across recently cleared fiel

The new dogs, although considerabl smaller, had a territorial advantage. Th interaction between pet and nonp stray has many implications for the p owner concerned about disease and d fights.

At 7:10 Shag found a garbage ca on its side and pulled out wrappin frequently used for food take-out o ders. He ate what appeared to be a po tion of spaghetti with bread.

At 7:13 both dogs left the can, and surveyed what remained of the "kill Shag had finished all the spaghet bread, and sauce, but had left prune raisins, and tobacco.

After more travel, through alleys a a playground, both dogs came to rest the median strip a block away from t homesite. While on their stomachs th



oth stared intently at a building diag- nally across the street. Fortunately, e median had benches and I could st too. They were not sleeping but ere waiting for something to happen. lthough I could not figure out what.

At 7:52 we all heard a human histle. The dogs immediately ran to e building they were watching. here a woman dropped food to them om a second floor window: hot dogs Dobe and chopped meat to Shag.

This was yet another food source. (In terviewing residents of my study reas, I now include a question about eding strays. About 20 percent have nswered affirmatively. Usually food is st put out for any dog that finds it.) This feeding stop, while not daily, was somewhat regular for Shag and Dobe.

After another short walk around the area, the dogs returned to the homesite for more water; by 8:43 they entered the shrubbery, which was 3 degrees cooler than the air temperature of 67° F. They rustled around in the bushes, often changing positions, but settled down to sleep by 10:20 A.M.

In 4.3 hours, Shag and Dobe had spent 124 minutes resting and 137 minutes moving about. Even during their activity period, much time was spent resting, possibly because food and water were so readily available. Another sign of the availability of food was the relatively small home range for a carnivore. By plotting all sightings and connecting the outermost points, I judged their home range to be not more than 0.1 square mile.

During their morning's activity, they spent 29 minutes feeding and 2 minutes in social contact with other dogs, which was below average. From my observations of Shag and Dobe on previous days, I knew that they would not leave their homesite in the shrubs during the heat of the day, so I went home for some food and rest. In the evening, I picked them up again as they made a similar, slightly shorter round of their territory.

During the summer and early fall I observed Shag and Dobe's routine for many days and nights. The morning just described was a typical one for a feral urban dog. I had selected Shag for this intense study partly because I could identify him easily, but also because—like the woman who threw the preferred tidbits to Shag—I had become fond of him. So when both Shag and Dobe disappeared late in the fall, I was concerned and curious. And their fate was important for my study, because the causes and rates of mortality are important information for an understanding of the ecology of an animal population.

Shag could have been killed by a car, for he had had many close calls. Often as an auto approaches, dogs appear to act submissively—whimpering, crouch-

A narrow passageway between two houses led to the den of a feral bitch and her pups. In the city, stray dogs find a variety of den sites, including empty houses and garages, hallways and basements, abandoned cars and rubbish dumps.

In a poverty area of Baltimore, a policeman and spectators wait for a dog pound truck to arrive and pick up an injured dog that had been struck by a car. About one-fifth of the city's dog population is killed by cars each year. Because of poor garbage storage and pickup and the number of abandoned buildings, there are many more feral dogs in ghetto areas. The incidence of dog bite is high. Yet the residents of these areas tend to be sympathetic toward the dogs, feeding and caring for them; even chasing them off when the dogcatcher appears.

ing with ears back, and holding their ground. They do not necessarily jump back reflexively as humans do. This behavior, together with their propensity for chasing fast-moving objects, may be why many dogs are injured by cars. In a review of veterinary hospital records, Tom Large, a freelance writer, found the car to be the most common source of dog injury, and Edward C. Harmon, Jr., superintendent of Baltimore's Animal Shelter, estimates some 17,000 dead dogs are collected from the streets yearly by his scavenger service. I suspect most are car kills. This high annual mortality of about one-fifth of Baltimore's dogs (a conservative estimate, since not all dead dogs are found) means that few feral dogs live to an old age. Therefore, a younger population is maintained. Younger animals are more susceptible than older ones to diseases such as rabies, distemper, and *Toxocara* infection.

As he was a stray on the streets, Shag could have been collected alive by the Animal Shelter. Captured dogs are held for some time so they can be retrieved by owners or adopted. Eventually, dogs that are not claimed are humanely killed (more than 6,000 dog a year are too many for continuou boarding) and rendered into anima proteins for hog food supplement or lov phosphate grease for soap. This recycling is consistent with ecology and a sensible and safe solution to the problem But this was not Shag's fate, because visited the shelter many times and di not find him.

Man is very much a part of the ecology of the stray dog in the city. Bor beneath the porch of an empty house o in the trunk of a junked car, or release as an unwanted pet, the feral dog's lif cycle is continually involved with th works and actions of man. His food supply comes from the handouts and th garbage of man. And most often hi death, beneath the wheels of a car (as feared for Shag) or in the vacuu chamber of the S.P.C.A., comes at th hand of man.

The dog, in turn, is part of the ecology of urban man. Baltimore city veterinarian Dr. David R. Berzon handles reports of some 7,000 dog bites yearl (there are probably at least twice tha many). Children under 15 years of ag are the usual victims (60 percent of al

ites) and up to 30 percent of the biting
ogs are strays that are never retrieved
or examination. Fortunately rabies is
ot yet a problem in the area.

Not only do dogs bite, they also dis-
upt garbage, defecate, chase cyclists,
nd bark: all impingements on the qual-
y of life of the urban dweller. In many
ays dogs compete for, as well as share,
e urban environment with man. But
ese sources of conflict are solvable
ith responsible ownership, leash laws,
alth codes for in-house toileting or fe-
l retrieval ("scoop law"), city plan-
ing to include dog areas, and educa-
on to include an understanding of dog
havior (teaching children how to
oid being bitten). Some regulation of
g numbers will undoubtedly be
cessary.

My concentration on the stray dogs
Baltimore has blurred the real advantages of the interrelationship of man and dog in the city. At times of great social stress, of fear and loneliness, the well-cared-for dog is a source of companionship and pleasure. The dog owner develops a view of another species, of a type of wildlife that is all too often missing in the urban ecosystem.

This last point became evident to me about six weeks after I lost track of the two dogs. One day I observed Shag being walked on a leash by a man. Shag was still quite shy, but he appeared to be enjoying his new domestic life. I interviewed the man, who told me he had taken in both Shag and Dobe, who was living with a relative in the suburbs. He reported that the veterinarian felt that although Shag did have worms, he was generally healthy and at normal weight. This was further proof of the ample food supply for Baltimore's feral dogs.

Occasionally his new master lets Shag out unattended in the mornings, and I have since observed him checking out the garbage cans along some of his old rounds. But Shag's range is much smaller now, he rarely eats anything, and he quickly returns to his new homesite.

Two city dogcatchers try—unsuccessfully—to lasso several stray dogs on a residential street in Baltimore. Each year they capture or retrieve from people's homes more than 11,000 dogs, most of which are destroyed and rendered into animal protein for hog food supplement—a form of recycling. Many strays can apparently recognize the dogcatcher's, or similar, trucks and flee when their predator appears.

Social Climbing in the New Hebrides

In ceremonies that provide the lifeblood for local art, the men of north Ambrym rise in rank beneath the silent gaze of carved ancestors

by Kal Muller

Etoul swung his ceremonial club in a wide arc and brought it crashing down on the head of the small pig. For the men of Fanla, a remote village in the New Hebrides, the death blow was the signal to begin the carving of the fern trunk for the *nimangi* ceremony. Eleven days earlier, after several days of drenching rain, Etoul had found the right size fern tree in the forest near the village and had marked it with a machete. Other men from Fanla cut the tree down, and as they dragged it to the ceremonial ground, they chanted a song associated with the pulling of any heavy object through the bush. Reaching the sacred grounds, the men beat tall, hollow drums for about a minute. This drum beating would be repeated as each phase of the carving was completed.

The village of Fanla, located several hours by foot trail from the northern coast of the island of Ambrym, has no art galleries. But the age-old forms of Melanesian art persist here. The creative potential of the people is inextricably linked to their daily lives, and every man is a potential artist.

In the few parts of the New Hebrides, such as Fanla, where the destructive impact of European culture has been least felt, the people live in village clearings in the midst of dense jungle. The hot, humid climate and heavy rainfall produce a lush growth of giant trees, brilliant foliage, and multicolored flowers. But the New Hebridean archipelago is also a violent region of frequent typhoons, huge tidal waves, and severe earthquakes. Rich and terrible, these islands have left a deep imprint on the people and have imbued their art with dramatic human content.

Throughout Melanesia, art is an integral part of many ceremonies that are fundamental to the culture. In Fanla the most important ceremonies involve changes in the rigidly graded social levels. Much of a man's life consists of a single-minded progression through a series of complex and energy-demanding social grades. Position is not hereditary. Through his own efforts, each man must accumulate the wealth (traditionally in the form of pigs) necessary to advance from grade to grade. After his death his importance and position as an ancestor will depend upon the grade he was able to attain in his lifetime.

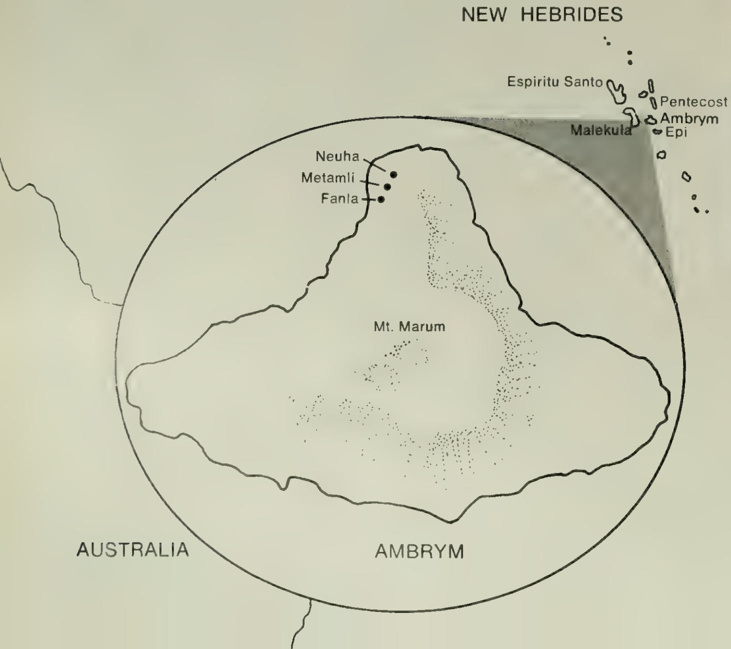
A higher grade also gives a man a more decisive voice in all communal decisions. Thus, the *nimangi*, as this graded organization is called, replaces chieftainship. Such a social system creates a gerontocracy, since normally only the older men have amassed sufficient wealth to reach the higher grades. The higher-graded men must give consent for a man lower on the social ladder to move up.

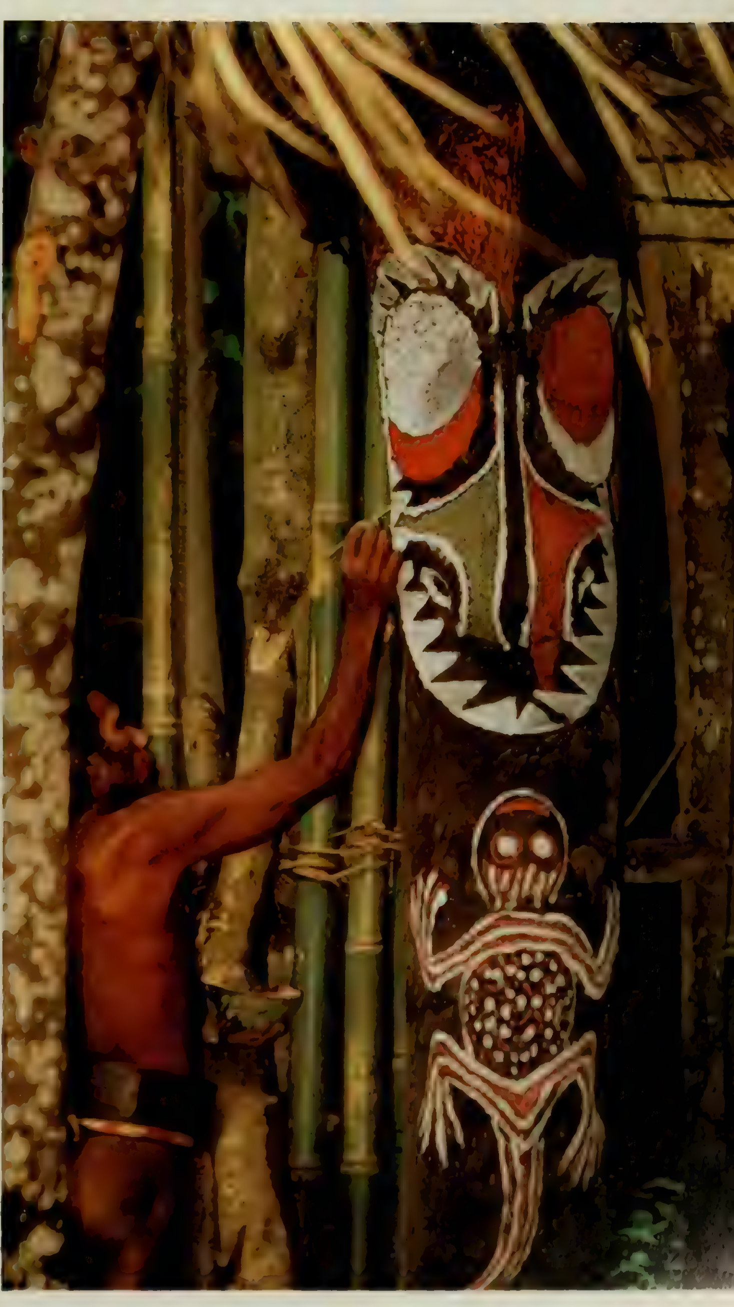
On Friday, July 24, 1970, eight men in Fanla moved up to the grade of *sagaran*, the sixth in a 13-grade system. About eight months before, two men had asked Tofor, one of the most powerful men in the north Ambrym region, if a *nimangi* ceremony could be held for them. After consultation, Tofor, his father (the highest-graded man in Fanla), and the other high-graded men consented. At the same time they also gave permission to six other young men who were ready for the *sagaran* grade to join in the *nimangi*.

Tofor received most of the payments for this *nimangi*. The eight men shared the expenses of the ceremony equally. Each gave Tofor at least three pigs, and together they contributed some 25 Australian pounds, which Tofor distributed to higher-graded elders. (Although Australia adopted a new monetary system in 1966, in some remote areas islanders continue to use the pound.) The carving of the fern trunk was Tofor's responsibility, although Etoul, his brother, marked the general outlines of the design. Special designs are carved for each grade ceremony. For *sagaran*, Tofor cut a 3½-foot-long human face, with large circular eyes into the thickest end of the log. Fou inches under the chin, he carved a 2¼-foot lizard. The beating of drums accompanied the first whonk of the metal-bladed adz into the porous surface o the fern log, which was carved in les than three hours.

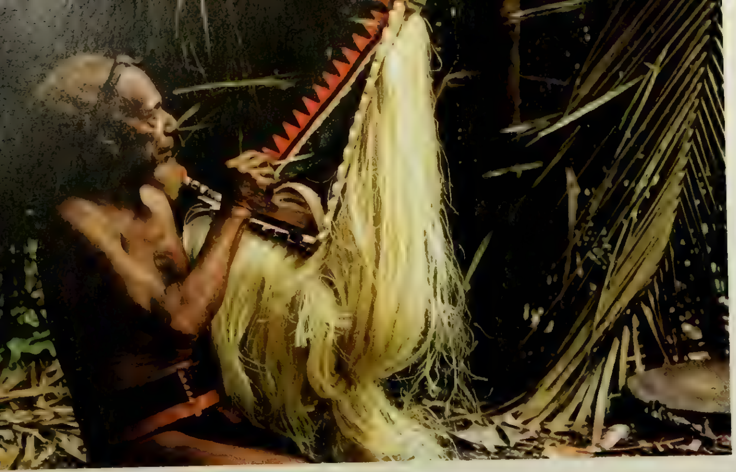
After the carved fern trunk was se upright beneath a tall ceremonial plat

Fanla men fasten lianas to a fern trunk, above, in order to drag it to the ceremonial ground for carving. At right, white paint made from powdered coral limestone is applied to the carved surface by Tofor.


NEW HEBRIDES
Espiritu Santo
Pentecost
Ambrym
Malekula
Epi
Neuha
Metamli
Fanla
Mt. Marum
AUSTRALIA
AMBRYM



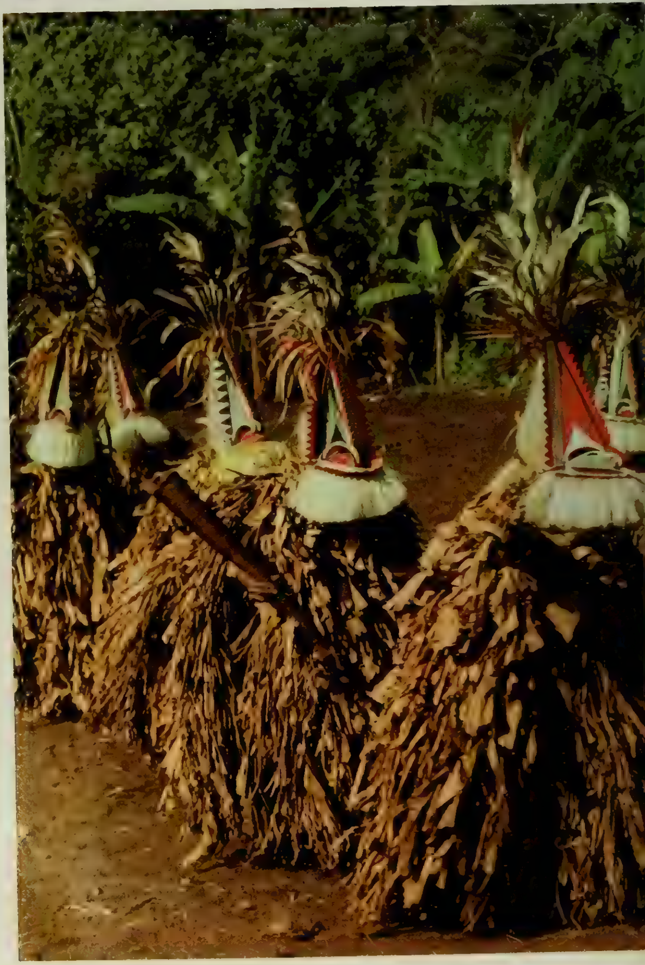
he face and lizard design
or the grade of *sagaran*
some finishing touches.
ht. During the *nimangi*,
following page. Tofor
ces on a platform above
he carving as candidates
circle a slit drum to a
eadily increasing tempo.



form, its surface was sealed with a mixture of volcanic ashes and coconut milk. Tofor did most of the painting, using four colors. Black was made from wood ash; white from coral limestone. A hardened clay from Pentecost Island to the north of Ambrym was used to make green. A special fruit imported from the tiny island of Laaman, south of Ambrym near Epi, was crushed, heated, and dried to prepare a deep brick-red paint. The dramatic effect of much New Hebridean art is achieved by painting these bright, contrasting colors over the fantastic interplay of curved lines in the carvings.

The day of the *nimangi* passed in a series of dances and ritual events.

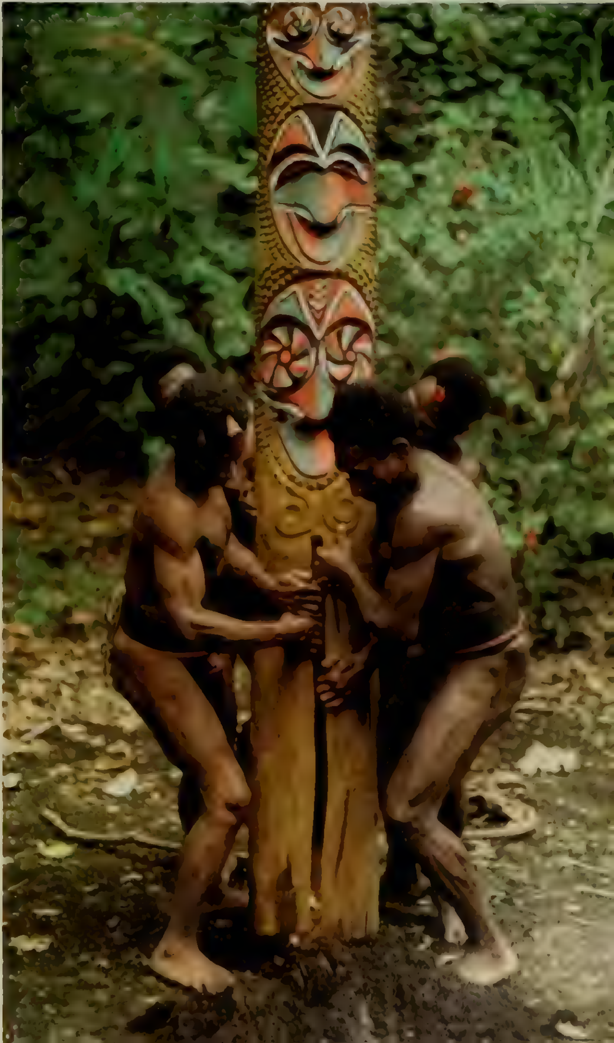
Techniques of making elaborate *rum* dance masks are zealously guarded. Above, a man from Neuha paints the face of a mask for the Fanla ceremony. Clad in banana-leaf robes, *rum* dancers, right, make their way in a slow procession from the village to the dance ground. Slit drums, far right, carved from breadfruit trees, are used ceremonially and to send messages.



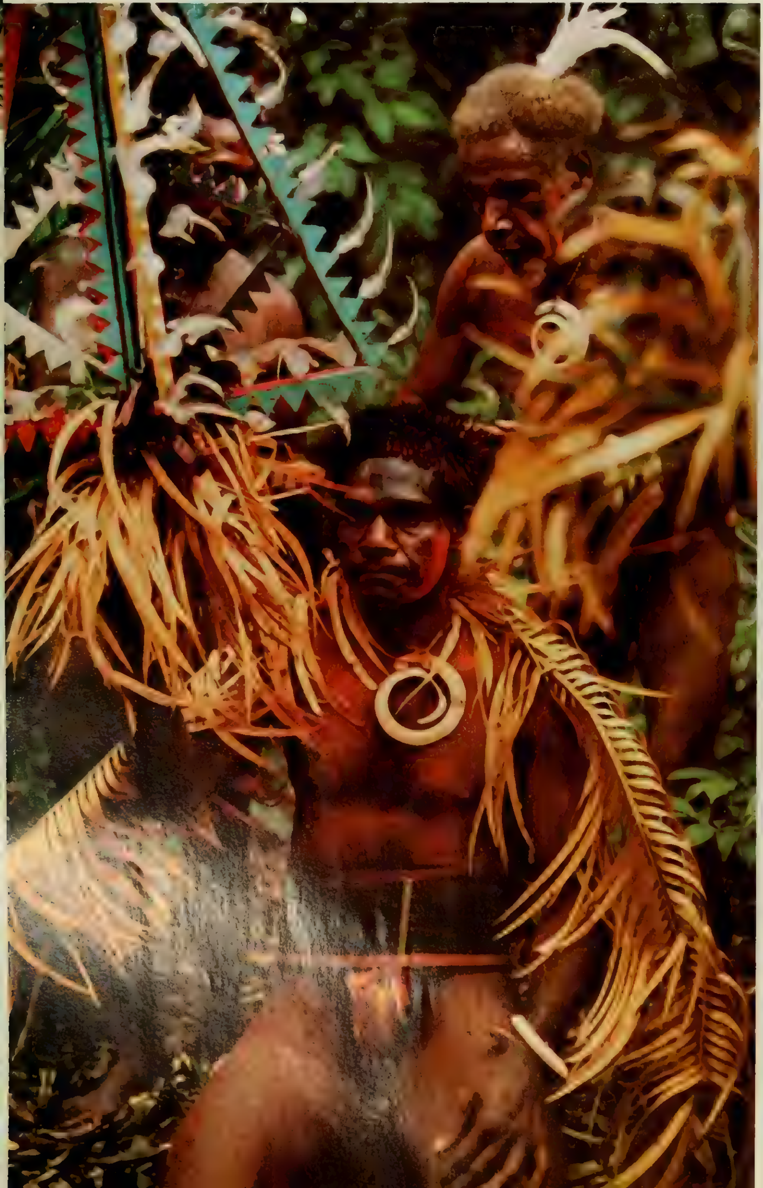
Vhen the dancing finally ceased, a arge tusker pig was killed. Each man vho took the grade of *sagaran* that day truck the head of the pig and called ut his new ceremonial name.

Most of the pigs given in ayment by the *sagaran* candidates vere represented at the ceremonial round by bits of lianas that were exhanged at the end of the *nimangi*. Toor said that some of the pigs he reeived would be given to his mother's relatives at nearby Metamli. He explained that after a man dies, his spirit resides in his mother's village. For the "devil" of that place to allow his spirit to remain there, a man must, over his lifetime, give a sufficient number of pigs to his mother's side of the family. If not enough pigs have been given, the devil will throw the man's spirit into Marum, one of the volcanoes in central Ambrym.

The accouterments used in rituals such as the *nimangi* are usually made for a single ceremony. As the polychromy of brilliant earth pigments on the fern log fades, so do the life and meaning of the carvings. Great faces of ancestral figures, the silent witnesses to



A Nimangi for Tofor



In 1969, a *meleun getla*
grade ceremony was he
for Tofor, one of the m
important men in nort
Ambrym. Older men
helped prepare his
costume for the great
event, which elevated h
to a rank only two grad
below that of his fathe
Tein Mal. Blowing a
conch shell, above, Te
Mal announces the killi
of a pig for the *niman*
Tusks from pigs killed
earlier ceremonies
encircle his arms. In
April of this year, Tei
Mal died, making Tof
the highest-graded
man in Fanla.

ach man's rise in the social hierarchy, nust be brought to life anew for each eremony.

Also made for one-time use are the laborate masks worn during ceremonies known as *rum* dances. Knowledge f the mask-making techniques is losely guarded and is sold by the men who last sponsored a *rum* dance to hose who wish to hold such a dance at heir village. According to Tofor's father, these dances originated many ears ago in the north Ambrym village f Wes. As knowledge of the dances nd masks passed through one north Ambrym village after another, changes n style and content were added. In the ast, the dances were associated with he normal exchange cycle between villages, and usually occurred when there was a surplus of pigs or other foods that igured importantly in the dances.

The infrequency of *rum* dances owadays is blamed on a shortage of igs to pay for the costumes. Until last ear, no *rum* dance had been held in anla since World War II. Two of the nen who, at that time, had the necesary expertise to construct masks had lied. Two others had nearly forgotten he techniques. Tofor and three other nen from Fanla decided to get help rom experts living in nearby villages. This cost them 222 Australian pounds nd a pig worth 50 pounds.

It takes several days to make the *rum* nasks, and the work is done secretly ehind a wall of palm branches. The nasks are built on a framework of liable branches, to which are attached hin sections of fibrous inner bark from palm tree. This forms the basic shape f the mask, which is reinforced with trips of soft wood tied to its contours. nner layers of banana tree trunk, dried n the sun to make them soft and silky, re used for the hair and beard. After a ose is modeled on the mask with a reddish paste made from a claylike material, it is set out in the sun to dry and harden. Palm branch, carved in a sawtooth pattern and pinned to the mask with orange tree thorns, is sometimes used, and rooster feathers may be attached to the top. Colors, similar to those used in painting the fern carvings, are then applied.

Based on variations in this construction pattern, the masks can be grouped into three types: the *rum tin*, or ordinary mask; the *rum kon*, or sacred mask; and the *rum tatatoro*, the highest mask. The differences between the types are found mainly in the paint pattern and in the arrangement of the sawtooth pattern. Two other items essential to the dance, made at the same time as the masks, are the *rablar*, or banana-leaf robe, and the *weran rum*, a three-foot-long, cone-shaped basket filled with dried bancoul nuts that is used as a rattle.

In the *rum* dance at Fanla, which was held about two weeks after the *sagaran* ceremony, the men performed to the cadence of monumental, upright slit drums. These drums, some more than ten feet high, are set up in one corner of the ceremonial ground. To make one is an arduous task: using an adz, the trunk of a breadfruit tree is hollowed through a longitudinal slit. To provide varying tones, one lip of the slit is thinner than the other. The most distinguishing feature of a drum is a large, quarter-moon-shaped face, with huge round eyes carved in high relief in the upper portion. Frequently, small arms protrude from the sides of the jaw. If the drum is being made for a high-graded man, extra features may be added. Sometimes rows of sawtooth pattern are incised on either side of the face, along with extra curved lines. Other faces might be carved on the front and back of the drum.

The fern carvings, masks, and slit drums of north Ambrym provide some of the best examples of New Hebridean art. In the culture of this area, it is as difficult to differentiate between secular and religious art as it is to determine the limits of an individual's natural and supernatural life. As in all of Melanesia, life here has been an unbroken progression: nature, man, ancestors and ancestral spirits, supernatural spirits, forces of nature. But this is slowly changing. As recently as the period just prior to the Second World War, a visitor to Ambrym or other islands such as Malekula and Espiritu Santo could still squat in a jungle hut and watch cannibals prepare for a *nimangi* and carve an ancestral face in a fern trunk. Even then, however, on other, nearby islands lived beskirted, pidgin-speaking, hymn-singing copra producers. Today, cannibalism is nonexistent, and fewer than 200 villagers in north Ambrym and neighboring Malekula carry on the traditional mode of life that intertwines art and ceremony.

These people are just now becoming aware of the interest of outsiders in their art. Some of the best examples of masks and drums, the work of local craftsmen produced for local use, can be found in museums and private collections throughout the world. Today villagers are beginning to make articles destined only for sale to visitors. Although the articles are stylistically similar to those used in local rituals, the workmanship is usually poor in comparison. As intruding Westernization makes the art of the New Hebrides commercial, the once-common masterpieces become rare.

Her Majesty's Faun

on the Bounding Main

When Henry Moseley sailed as a naturalist on the epic voyage that began modern oceanography nearly 100 years ago, he included in his journal accounts of the creatures—human and otherwise—on the Challenger itself

by Susan Schlee

Britain's famous *Challenger* circumnavigated the globe in the years 1872 to 1876, and the event is used by many to mark the beginning of modern oceanography. Charged with studying all aspects of the deep sea, the ship sailed some 69,000 miles and returned to England with vast collections of fishes, seaweeds, plankton, sea-floor sediments, water samples, temperature and salinity measurements, stuffed birds, old bones, and crates full of miscellaneous mementos.

To carry out so ambitious a program of oceanographic investigations and general collecting, the *Challenger* had on board a remarkably small scientific staff. There were four naturalists, a chemist, and an artist-secretary; but in spite of all the work to be done, each of these men found time to keep a private log or journal or, at the least, to write long, descriptive letters to his family. Several of these personal narratives were later published, and perhaps the most charming among them—for it is the most honest and least pretentious—is the book by Henry Nottidge Moseley, *Notes by a Naturalist on the "Challenger."*

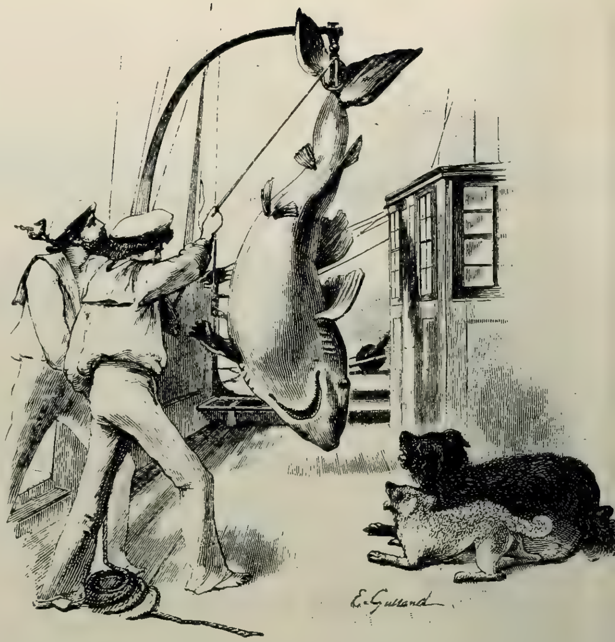
Moseley, born in 1844 in Wandsworth near London, was in his late twenties when the voyage began. He had studied biology in Vienna and Leipzig, and had gained some experience on British expeditions by accompanying a government eclipse expedition to Ceylon. Moseley had been asked to join the staff of the *Challenger* as an expert on corals with additional duties in such diverse fields as botany and anthropology. This variety of tasks suited his temperament, and he declared that he took an active interest in all that went on aboard the *Challenger* even, as this account from the last section of his book discloses, in the "zoology and botany of the ship."

• • •

The zoology of "Challenger" itself was rather interesting. At the time that England was left the ship seemed nearly free of animals, other than men, dogs, and live stock required for food. The first Cockroaches apparently came on board at St. Vincent, Cape Verdes, for a large one of these insects was caught by one of the lieutenants on his bed, soon after we left that port. Cockroaches soon became plentiful on board, and showed themselves whenever the ship was in a warm climate. A special haunt of a swarm of them was behind the books in the chemical laboratory, from which Mr Buchanan [the chemist] in vain attempted to evict them.

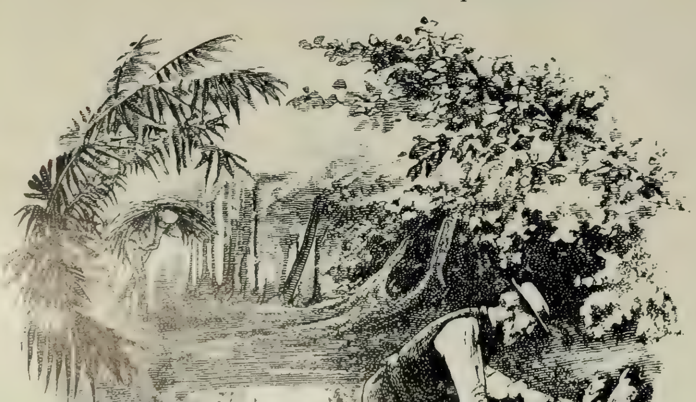
At one period of the voyage a number of these insects established themselves in my cabin, and devoured part of my boots, nibbling off all the margins of leather projecting beyond the seams on the upper leathers. One huge winged Cockroach baffled me in my attempts to get rid of him for a long time. I could not discover his retreat. At night he came out and rested on my book-shelf, at the foot of my bed, swaying his antennae to and fro, and watching me closely. If I reached out my hand from bed, to get a stick, or raised my book to throw it at him, he dropped at once on the deck, and was forthwith out of harm's way.

He bothered me much, because when my light was out, he had a familiar habit of coming to sip the moisture from my face and lips, which was decidedly unpleasant, and awoke me often from a doze. I believe it was with this object, that he watched me before I went to sleep. I often had a shot at him with a book or other missile, as he sat on the book-shelf, but he always dodged and escaped. His quickness and agility astonished me. At last I triumphed, by adopting the advice of Captain Maclear, and shooting him with a pellet of paper from my air-gun, a mode of attack for which he was evidently unprepared; but I was taken to task for discharging the air-gun in my cabin, because it made a noise just like the sharp crack of a spar when broken by the force of the breeze, and created some excitement on the upper deck, where the sound was plainly heard. . . .



The ship's dogs bark at a shark being swung on deck.

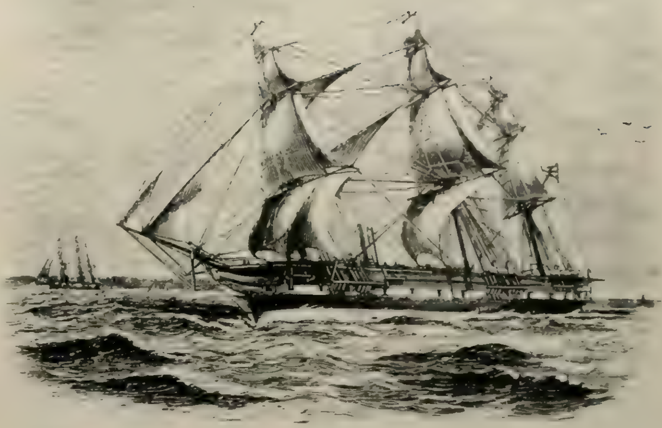
Henry Nottidge Moseley collects plants ashore.



House-crickets appeared in the sh
towards the end of the voyage, and t
of them established themselves in St
Commander Tizard's cabin, to his gre
annoyance, as they were as noisy as
home. They were, however, caught wi
some difficulty. Centipedes, of t
kinds at least, were also amongst t
navifauna, and many species of spide
Some of these latter were, however,
liberately imported on board by t
navigating officers, in order that th
might use their webs, if wanted,
cross-wires in their theodolites.

When the ship was moored at B
muda, alongside the wharf in the do
yard, boards were placed on all
mooring chains as a fence against ra
Rats nevertheless appeared in the sh
and were all curiously enough of the
species, the Black Rat *(Mus rattu*
One night, as we were sitting at wh
Mr. J. Hynes, the Assistant Paymast
suddenly started up with a yell, a
danced about as if gone mad, clutchi
one of his legs with both hands. A
had mistaken his trousers for a pipe
wind-sail, and had gone up.

The only plants which made th
spontaneous appearance on the s
were Moulds. Whenever the ship
tered damp latitudes everything in
cabins on the lower deck became mo



The *Challenger* used steam and sail to circle the globe.

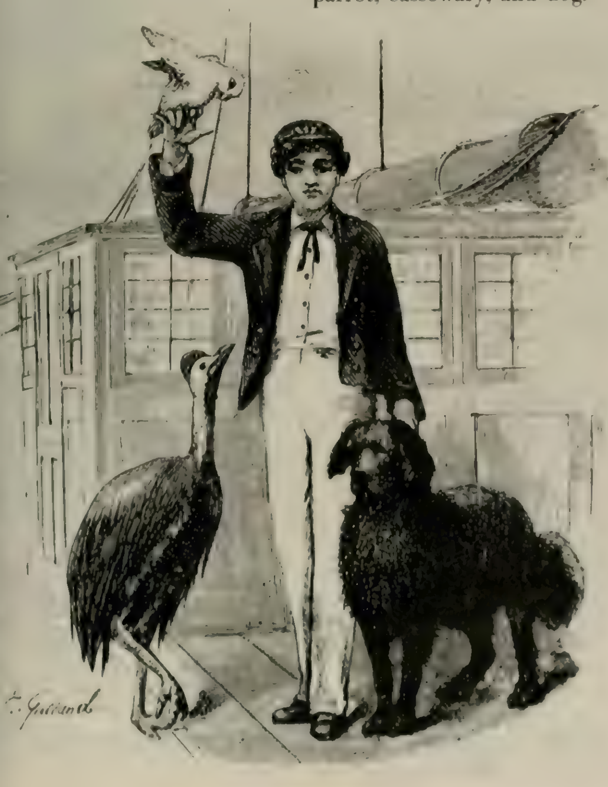
nd mould grew thickly over boots and ll other leathern articles. I grew mus-ard and cress with great success in my ardian cases before these were re-uired for other purposes. I failed, how-ver, entirely with onions and radishes, hich I also tried to grow. The plant ost commonly grown on board ship in he tropics is the Sweet Potato. It can e grown in water and made to climb p the wall of a cabin and afford a leasant green.

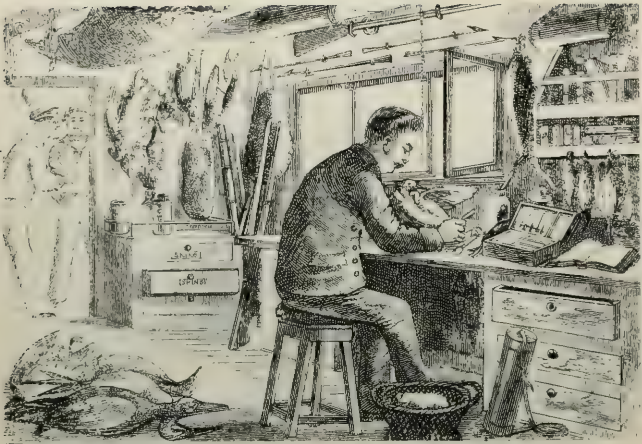
Besides Dogs and Cats we had many ifferent pets on board the ship at vari-us times. First amongst these must be laced "Robert" the Parrot. The bird elonged to Von Willemoes Suhm [an-ther of the naturalists]. He and I ought a young Grey Parrot each at ladeira, from a ship bound from the ight of Benin to Liverpool, with a argo of these birds on board. One of he Parrots flew into a dish full of boil-ng . . . potash solution in the labora-ory and perished, and we had to draw lots for the remaining bird, and I lost.

"Robert" survived all the extremes of the heat and cold of the voyage and perils of all kinds, from heavy tumbles, driving gales of wind, and the falling about of books and furniture. He had one of his legs crippled, and his feathers never grew properly, but he was perfectly happy, and from his perch, which was one of the wardroom hat-pegs, he talked away and amused us during the whole voyage. His great triumph, constantly repeated, was "What! two thousand fathoms and no bottom? Ah Doctor Carpenter, F.R.S." [William B. Carpenter, a Friend of the Royal Society, had helped organize the *Challenger* Expedition but had chosen not to join the staff.] He ["Robert"] knew his own name perfectly, and I have known him to climb over the ledge in at the door of the cabin of Dr. Maclean, his chief friend, when I have been sitting there on a dark rough night, after he had come to grief and tumbled off his perch with a thump, plaintively appealing with "Robert, Robert."

After leaving the Aru Islands a young Cassowary roamed about the decks for some time, but was soon killed as a nuisance. No doubt, had it not been killed, it would soon have committed suicide, like an Ostrich on board one of the men-of-war at the Cape, which stole a piece of hot iron put down by the blacksmith beside his forge, and swallowed it hastily with fatal effect.

A young officer with parrot, cassowary, and dog.





A biologist removes a bird skin for return to England.

At Monte Video some very young South American Ostriches *(Rhea Americana)* were brought on board the ship. It was amusing to see them chasing flies on the upper deck, and, as they darted forwards, instinctively spreading their little wings as sails to catch the tiny draughts reflected from the bulwarks. Mr. Darwin has described the use of the wings as sails by the adult birds on the plains of Patagonia. [Darwin was greatly admired by Moseley, who dedicated his book "to Charles Darwin . . . from the study of whose journal of researches I mainly derived my desire to travel round the world. . . ."]

At the Sandwich Islands, two large living Tortoises from the Galapagos Archipelago were received on board from Captain Cookson, R.N., who had visited the group with the special object of collecting the very curious Tortoises found there. The Tortoises were fed a good deal on pine-apples, a number of which were hung up in the Paymaster's office. The animals used to prop themselves up against a board put across the door of the office to keep out dogs, unable to surmount the obstacle, and used to glare and sniff longingly at the fruit. They also learned to know their way along the deck to the Captain's cabin, where there was another store of Pineapples, and where they were often fed.

At Madeira, I had given to me some living specimens of the huge Spiders *(Lycosa)*, which inhabit the "Desertas," small outliers of the island, and which feed on Lizards, which they hunt and kill. I fed the Spiders on Cockroaches. One of them escaped, but it was brought back to me after a week by Captain Maclear, rather crushed, he having discovered it with his toe in the extremity of one of his boots. . . .

We should have liked to have had a pet Monkey with us, but Monkeys are strictly forbidden, by a special Admiralty regulation, on surveying ships, because one once destroyed a valuable chart which had just been completed with great labour. Even a Marmoset, which I brought at Bahia, was considered to come under the regulation and perished in consequence.

Concluding Remarks.—I did not su fer at all from the confinement of shi life. . . .

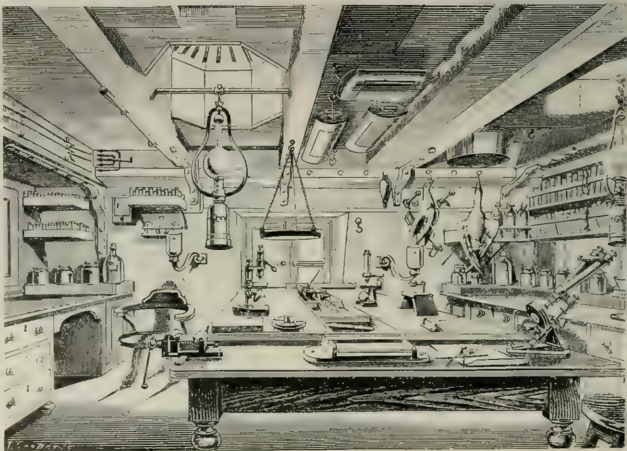
There are many worries and di tractions, such as letters and newsp pers, which are escaped in life on boar ship, and the constant leisure availab for work and reading is extremely e joyable. I felt almost sorry to leave, Spithead, my small cabin, which me sured only six feet by six, and return the more complicated relations "shore-going" life, as the sailors term i I had lived in the cabin three years an a half and had got to look upon it as home.

* * *

The expedition over, Moseley spe the next several years working out th results and writing reports on the cora and other animals he had collected. I 1877, he interrupted his marine studi to take a trip to the United State where he visited Oregon and Washin ton to observe the Indians living ther He believed these "native races," as h called them, to be fast disappearin and upon his return to England he s down what he had learned about the in a book on the State of Oregon.

In 1881, Moseley became profess of human and comparative anatomy Oxford and that same year married th daughter of the famous conchologi Gwyn Jeffreys. Moseley remained Oxford for the rest of his short life. H died in 1891 at the age of 47. His on son was the brilliant physicist Hen Gwyn Jeffreys Moseley.

Spacious zoological laboratory on the *Challenger*'s main deck.



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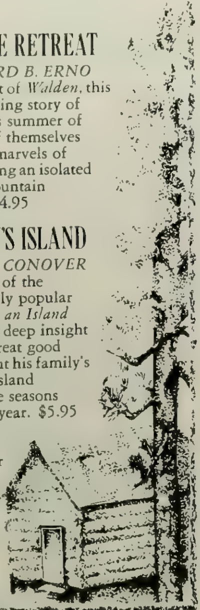

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Greetings from Los Angeles

Continued from page 20

burned hydrocarbons and carbon monoxide. These gains are widely advertised by the industry. But the corollary has been an increase in the oxides of nitrogen, which stunt plant growth, corrode metal, create brown haze, irritate the eyes and throat, and weaken the air sacs of the lungs. Also, the level of pollutant production varies greatly with the age and maintenance of the individual car. Measurements made with finely tuned automobiles right off the assembly line do not give a realistic assessment.

In any case, claims for lowered smog potential in an air trap such as the Los Angeles Basin must always be measured against a total combination of factors. A basin has a limit to its air-cleansing system and life-support capacity—much more so than any other kind of setting for a metropolis. No one challenges the fact that car registrations have continued to increase. Thus in the same six-month period (early 1971) that industry-sponsored ads first appeared announcing 20 percent decreases over 1966 in engine-produced carbon monoxide, the Los Angeles area experienced several major alerts because of carbon monoxide. These were the first such alerts in a number of years, and may be a portent of more serious problems yet to come.

Despite these and other danger signals, the auto barons show little interest in funding the all-out drive necessary to find and implement alternatives to the internal-combustion engine. In vehicle-related industry, the threat to profits from production of a simpler, more efficient, and more durable engine that can burn cheap fuels is, undoubtedly, very great. So while claiming great efforts to help end pollution, and publicly decrying the hardships forced on them by "unrealistic" government clean-air standards destined to go into effect in a few years, the manufacturers are busy patching up and saving the engine that has well earned the title, "The Poison Air Machine."

Catalytic afterburners are being touted as the smog device of the mid-1970s and beyond. Even if these burners live up to industry expectations, they still may not save the traditional automobile from the greatest crisis in its history. The devices will raise the price of cars by several hundred dollars. Further, there seems little hope that they will function efficiently for the life of

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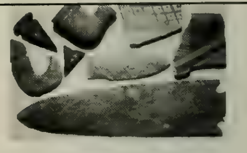

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e car. The contrivances will require reful maintenance and an effective stem of periodic inspection which es not, as yet, exist. How they will ork with respect to the millions of ler cars on the road, no one is pre- ared to say. In short, unless there is me major technological break- rough, which truly results in an ef- ient, inexpensive system of exhaust eaning, the projected antismog muf- r movement will become but another iot in a long string of industry cha- des. What will really be muffled, until e public gets wise, is why the auto d oil industries persist in giving prior- . attention to saving internal com- istion. For while there are, ad- ittedly, still formidable obstacles in e way of mass producing, say, the am-engine car, the difficult is not the possible. If the huge sums of money ent in the last five years on filtering aditional engine output, making arly model changes, and producing d advertising high horsepower and eed were properly devoted to re- arch and development, clean external mbustion would already be the power stem most commonly used in the cars today.

But perhaps the most immediate test industry and government's sincerity controlling air pollution will be how ey meet the serious threat posed by ided gasolines. Lead is a relatively eap octane or power-boosting in- edient that has been added to gaso- ies to insure smooth operation for the nd of high-compression engines pro- oted by Detroit. But lead is also a adly poison. It is a component of auto exhaust, and is taken gradually into the body through the lungs. Its effects are cumulative and result in a large number of health problems, beginning with such symptoms as fatigue, dizziness, cramps, and headaches, and eventually leading to a variety of disorders that can end in paralysis, brain damage, and death. A number of scientists suspect low-level lead poisoning as a cause of many of our ills.

In May, 1971, the Environmental Protection Agency finally admitted under prodding that air-sampling studies conducted in five cities in 1968–69 showed potentially dangerous concentrations of lead. Los Angeles' readings are indeed alarming, actually exceeding California Department of Public Health maximum standards for lead concentration in the air by 2 to 5 times. The permissible limit in California is 1.5 micrograms per cubic meter of air. But even the industry-proposed standard of 10 micrograms will shortly be exceeded at present rates of increase in lead levels. Thus the current flare for "low lead" gasoline and the well-advertised image of concerned environmental action by the oil industry—which once raised prices for putting lead in and now raises prices for taking the lead out. But low lead and unleaded gasolines work well only with small and low horsepower engines, a fact in direct conflict with Detroit's continuing hard sell for high power and speed. So far, substitutes for lead have proved costly. In fact, the lead content of premium gasolines has even been increased as part of a complicated fuel-mixing and pricing formula that has had the backing of the

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federal government.

On Los Angeles' crowded freeways, in its tunnels, and during traffic jams all the limits for polluted air are exceeded, possibly by as much as 50 times. At any given time, the chances are great that many parts of the basin are far over the safety limits for public health. The number of deaths from emphysema, a disease of the lungs, has risen markedly in our cities; the lung cancer rates are more than double those of Norway, a country noted for clean air. Teams of scientists recently have found and reported definite correlations between high levels of carbon monoxide in New York and Los Angeles and increased mortality. But the cars continue to pour into the basin and the smog hangs thick. In an era when politicians are quick to cry "law and order," little effective action is taken to protect the public health and safety. The mayor of Los Angeles, the nation's third largest metropolis, keeps busy chasing his pet butterflies—the problem of Red China and the UN; how to stop the Communist menace; questions of outer space; his dreams of the presidency—while the governor drifts far above it all on a cloud of his own. Down on earth the city simmers and the air rots and spreads its foulness to the surrounding countryside. Children cough, and parents work hard to forget.

Meanwhile the Environmental Protection Agency has at last begun to move: it has announced strict air quality standards to begin in 1973 and 1975. The states must submit plans for compliance with the new requirements by June 30, 1972. But the key limits—tight controls on oxides of nitrogen and ozone—have already been cal unattainable by the car manufactu and the California Air Resour Board. Both state and Los Angeles pollution officials have declared that federal standards are unrealistic that there is no way to meet the de line for submitting a plan that can implemented.

But what is realistic in this mad s of technology? Thirty years ago, any who proposed turning 50 percent downtown Los Angeles into freew and parking lots would have been nounced as a crackpot. Sixty years a anyone who proposed setting up chines around the city to vaporize sons into the air would have been c sidered a raving lunatic. But now the freeways and parking lots are h now that we all have our poison air chines in portable form no less, we reluctant to make judgment. We s to be able to do the things that pay c dividends in the short run, and find cuses not to do what might bring l run public gain. In our race for p ress, we have failed to look back; consequence, yesterday's flaws are denly today's habit and virtue. Thus have even come to accept murder long as the act meets several conditi provided by modern technology: (1 it is done in large numbers and pref bly in such a way that the victims c be seen—the obvious illustration is high-level bomber operating unde cense of war; (2) if it is done so sl that the victims don't fully realize v is happening; or (3) if it is done in s a way that, despite statistical evide of an increase in death rates, it is possible to prove conclusively that

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given death is directly attributable to the suspected cause. In the latter two categories, particularly, can be placed the modern environmental threats of atomic radiation and air pollution.

Perhaps what we must learn is really a very simple lesson: that nothing is more unrealistic than continuing to do what we have been doing. It is an intolerable situation to continue pumping billions of gallons of any substance into the air we breathe without some dangerous and unforeseen consequences. This is true be it gasoline or Chanel No. 5. The threat from lead, ozone, and from nitrous and carbon oxides is a real one. To keep on the present course of business as usual, to persist with the internal-combustion engine is to commit a thoughtless folly. There are emergency alternatives now available while the work of developing and implementing alternative power sources for the automobile is given priority attention. There are thousands of unemployed engineers who could contribute to this endeavor. Among the immediate actions that could be taken are these:

Stagger the work week so that freeway and downtown congestion are avoided and high-pollution levels from slow-idling engines are significantly reduced.

Equip all city and state patrol cars with electronic air pollution detection equipment and place vehicle pollution enforcement on a top priority basis.

Develop by 1973 a state master plan for mass transit in metropolitan areas of more than one million population:
first-stage implementation of the pl
by 1974 and completion by 197
(plan to be financed by federal, stat
and local sources, and a new tran
portation fund).

Change state law so that gasoline-t
revenue automatically goes to a ge
eral transportation fund, thus forci
highway lobbies to compete wi
other transportation media for use
public money.

Require warning labels to he
awaken and educate the publ
"Danger: Contains Lead—Poisonc
to Health" on all leaded gasoli
pumps; permanent bumper stick
for all new cars: "Danger: Intern
Combustion Exhaust—Hazardous
Health"; complete ban on lead
1973.

Electronically inspect the exhaust
all cars entering key downto
streets and freeway ramps on po
tion alert days; reject vehicles that
not meet air quality standards
emissions, plus a stiff system of fi
for repeated violators.

Grant state tax relief to compa
working directly on alternate po
sources to internal combustion.

Empower coroners to list s
as among the causes or prob
causes of death on official death
tificates.

Define in state law what constit
an air pollution emergency and a
pollution disaster (for example,
or more deaths from respira

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causes, during an alert, over and above the normal for a given period); provide state financial and medical aid to the victims and their families; beginning in 1975, allow civil and criminal suits for damages and death against manufacturers and importers of internal-combustion engines.

The war on smog will not be won easily in any case, and it will not be won at all if led by the faint of heart. It is not enough merely to say that the Golden State has the strictest air quality standards to be found anywhere in the nation. Those standards, however strong by comparison, are not sufficient for local conditions. A number of scientists are already convinced that Los Angeles will be the setting for a modern air pollution disaster that will dwarf what happened in Donora, Pennsylvania, and in London a number of years ago, when thousands died. If so, more thousands of people, particularly the very young and the old, will suffer and die. Then and only then, it can be assumed, the city, the state, and the federal government will fully awaken to their responsibility to protect the public health and the natural right of man to breathe clean air. Admittedly, no one knows for sure that this kind of tragedy will in fact occur. But the risk is definitely present and growing, and the price in human suffering for faulty risk taking is greater than public officials will dare admit.

The strange, hazy days now come more frequently. The basin yellows and a pall of death hangs over the City of the Angels. The traffic dull-roars without end, and the miasma drifts everywhere, broken periodically by bursts of sunshine and the winds off the life-giving sea. Especially after a rain, it is still possible to find glimpses of the orange-blossomed paradise that all came west to see and to love. But the freshness is quickly gone. The foul haze reappears, pressed down by a hot lid of air from the Mohave. The shroud closes on the majestic peaks to the north and east—Waterman, Islip, Baden-Powell, and San Antonio—and the people try to remember, and try to forget.

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I Went to the Animal Fair
. . . the Tiger a

by Judith Shapiro

THE IMPERIAL ANIMAL, by Lionel Tiger and Robin Fox. *Holt, Rinehart & Winston, Inc., $7.95; 352 pp.*

If ethology is defined as the biological study of behavior, then the term "human ethology" may be used to designate a relatively new field, which stresses the continuity between man and the rest of the animal world and seeks organic bases for the ways in which members of our species comport themselves. That this approach has captured the imagination not only of certain academic professionals but of the general public as well is evidenced by the popular success of books like Robert Ardrey's *African Genesis* and *The Territorial Imperative* and Desmond Morris's *The Naked Ape.*

A common interest in the ethological perspective has led Professors Lionel Tiger and Robin Fox, colleagues in the Department of Anthropology at Rutgers University, to contribute to this growing body of literature. They too have written a book aimed at a wide audience. *The Imperial Animal,* like the books by Ardrey and Morris, represents an attempt to identify basic and universal features of human behavior and to account for them through hypothetical evolutionary reconstructions. Once again, we are led back to our long-lived hunting career for an explanation of our behavioral history.

Tiger and Fox differ from these other authors, however, in the degree to which they emphasize the similarities between man and other primates. They are, to be sure, concerned with features unique to our own species, but see these as elaborations of our phylogenetic inheritance. Man is, to use their own term, super-primate. He has capitalize
on a legacy that includes a prolonge
period of maturation, permitting the de
velopment of complex patterns
learned behavior; a system of group in
tegration based on both the competin
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and a general and energetic curiosity.

In the course of their book, Tige
and Fox apply a comparative zoologica
approach to various phenomena that so
cial scientists usually treat in an e
clusively human framework. They vie
politics, in their opinion an essentiall
male affair, as a variation on the pri

The man/animal bandwagon, undoubtedly on its way to the bank. From left, authors Lorenz, Tiger, Fox. Ardrey, and Morris.

were there

te theme of dominance. They discuss length the two bonds that they take be most basic to human society—the between woman and child and that ween men—and argue that these ationships are governed by the same ds of biological mechanisms that in- e behavioral regularity in other spe- s. According to these authors, it is n's ability to establish a far-flung net- rk of social relations that most sig- icantly distinguishes him from other mals. Hence, the title: *The Imperial imal* is one who extends his domain ough exchange and alliance.

Tiger and Fox base their analysis on the principle that behavior, like anatomy, is the outgrowth of an evolutionary process. Species are characterized by particular behaviors as well as by anatomical features; genetic influence and phylogenetic relations are expectably reflected in the former as well as in the latter.

Accepting the general truth of this proposition, there are still difficulties in applying it, which must be recognized. First of all, as far as evolutionary reconstruction is concerned, we possess no "fossil record" of behavioral types as

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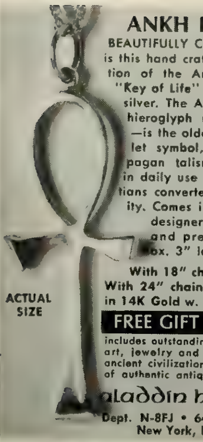

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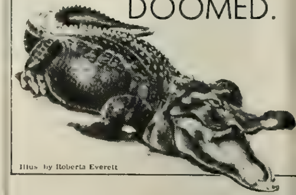
we do of anatomical types; an important source of direct evidence is thus lacking. Secondly, while we may assume a general relationship between genetics and behavior, our knowledge in this area is still highly fragmentary. How specific is the genetic code, especially in the case of an animal with an extremely developed capacity for learning complex and diverse behavior patterns? Does not man have characteristics that make him something of a problem child for the comparative biologist?

Tiger and Fox gloss over these issues rather offhandedly in a series of "of course" clauses: "Of course we have cultures," they note in passing; "Of course, training has a great deal to do with . . ."; etc. To those who stress the significance of culture, these authors enthusiastically respond by noting how this too is a part of our biology: "We have a *culture-acquisition device* constraining us to produce recognizable and analyzable human cultures . . ." (italics theirs). Now, really!

That our species' cultural abilities presuppose a certain genetic endowment is rather obvious; one does not exactly experience a sense of revelation when Tiger and Fox point out that learning is only possible for a creature with inherent abilities to learn. Furthermore, it is quite orthodox in anthropological circles to look upon man's capacity for symbolic behavior as the outcome of an evolutionary process. Although Tiger and Fox convey the idea that their profession is rife with latter-day special creationists, anthropologists are, in fact, generally aware that man is part of the animal kingdom. It is just that they feel his adaptation to be a unique one.

The authors of *The Imperial Animal* seem to believe that the only scientific way to approach the study of man is to look for human universals and that the only scientific way of explaining such universals is to invoke genetics. This position is open to attack on many fronts.

Leaving aside the obvious objections one might raise to these authors' particular catalog of "universals" (some are in fact not universal at all and others are so broadly defined as to be of little use), we could begin by taking them to task for their very cavalier treatment of cultural variation. It is inexcusable for anyone who claims a serious interest in anthropology to speak of societal differences as if these were somehow insignificant and arbitrary. One would never realize from reading this book that sense might be



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made out of the divergent ways in which human groups have developed.

Another problem with Tiger and Fox's approach is that they attempt to corner the evolutionary market with genetically determined traits. If selection, however, operates on an animal's *performance*, as these authors themselves emphasize, then there is no reason why evolutionary processes should not also apply to behaviors acquired through nonhereditary means. All that is needed is some mechanism that will enable the pattern in question to be passed on from one generation to the next, a mechanism that would seem to be provided by man's capacity to learn and to communicate what he has learned.

Tiger and Fox agree that sexual selection no longer operates for our species as it does for others. They do not seem to realize, however, that their evident distrust of extragenetic processes thus leads to a diagnosis of evolutionary rigor mortis. An alternative approach would be to take more seriously the idea of culture as adaptation, applying it not only to culture in general, but to specific cultural practices. Human variation could thus be studied in evolutionary terms without recourse to statements about "racial" differences. While such an approach widens the definition of what Tiger and Fox call a "natural process," it surely does not take us out of the realm of biology, nor does it preclude comparison between our own and other species.

To give a more specific idea of the way in which Tiger and Fox apply biological reasoning to the human condition, we might talk about an issue that lies at the heart of their analysis, namely, the question of sexual differences.

Tiger and Fox consider it a fact of nature that men should predominate politically, that they should form groups that exclude women, and that they should seek self-validation through a display of female subservience. Women, for their part, are inherently less oriented toward one another; bonds between them are of necessity ephemeral. Their lives are meant to revolve around child rearing, for which they are prepared in a number of emotional as well as structural ways. These and the other sexual differences are seen to be part of the human "biogram," a term that Tiger and Fox borrow from the physical anthropologist Earl Count. The word *biogram* refers to an animal's basic design for living; more specifically,

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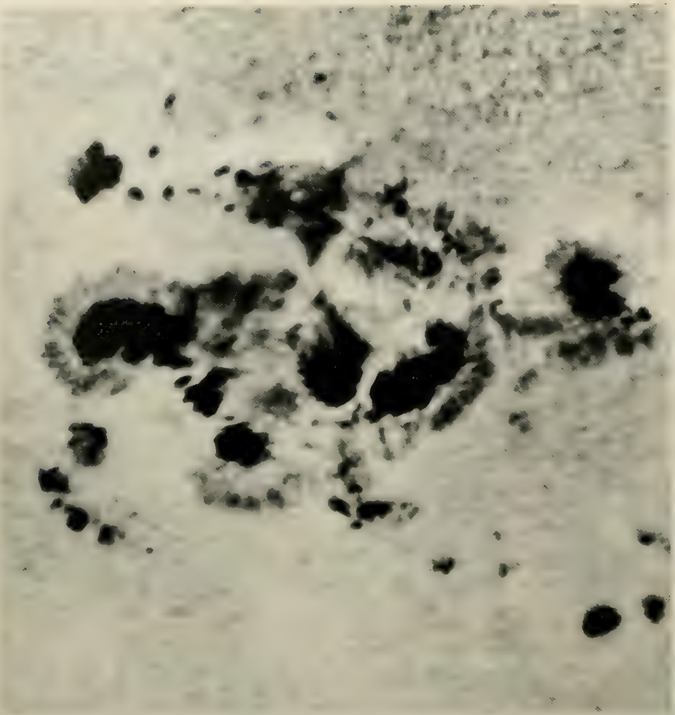

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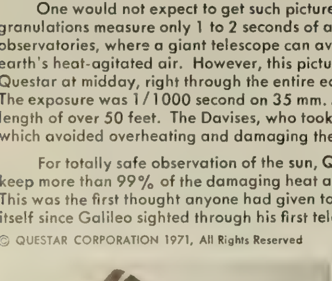

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it conveys the idea that the behavi patterns in question are part of the a mal's "wiring," another term Tiger a Fox are fond of using.

According to these authors, our o species' biogram is a legacy from c long history as hunters and has chang little in the relatively short time sir we invented agriculture and fell fr ethological grace. The hunting life v associated both with a sharp sexual di sion of labor and a rapid growth man's mental capacities—or rath *male* mental capacities, as Tiger a Fox seem to be saying. They claim tl different selection pressures were bei brought to bear on the two sexes a that the most significant pressur those associated with the need for co eration and response control, w being exerted on males. One wonders this point if these authors are speaki of some sort of parallel genetic desce with little boy hominids inheriting array of special abilities from their fi brained fathers and little girl homin having to make do with the lesser downments passed on to them from th mothers.

Again, we must stress that the sex division of labor could well have dev oped as an adaptive response with involving innate differences to the gree suggested by Tiger and Fox. If s cial mental capacities were indeed prerequisite for certain skills exerci by males, this does not itself mean t such capacities were not being pass on to males and females alike; it o means that men may have had more portunity to make use of this potentia

Similarly, one wonders if it is nec sary to shore up the maternal role by tributing to women a host of special havioral propensities. The pure fact t it is women who have the physi equipment to bear and suckle child and that the maturation period of th children is a protracted one would se to go a long way in accounting for different existential situations of the spective sexes. Thus, in societies wh motherhood can be combined witl wide range of other socially signific activities, or where alternatives to a rental career are encouraged, we mi expect the lives of women to vary cordingly.

The case that Tiger and Fox m for the innateness of temperamental ferences between the sexes rests u highly selective and distorted ren ings of endocrinological research on experiments that could not poss have accounted for the effect of cult tudes. The whole discussion of sex s is in fact characterized by a methlogical irresponsibility that afflicts rest of the book as well. Sentences deceptively connected by a "thus" "therefore" in the absence of emcal justification and sometimes with tal disregard for elementary logic. myriad footnotes, while of bibraphic value, lose much of their larly impressiveness upon closer exnation: one may even find that the rce for a particularly broad assertion single personal communication. grammatic statements about human ernity are juxtaposed with images of riented motherless ducks, and di leaps are made from the male ban with his harem of root-picking fes to the male executive with his of handmaidens from the typing l. Here we are clearly in the realm cientific malpractice.

he general upshot of all of this ious reasoning is an intimation that er peril or futility is likely to attend effort to alter the basic structuring nale and female roles. One wonders Tiger and Fox should quail so at prospect of rocking the sexual boat. ely they are unworthy heirs of those inids whom they are pleased to debe with epithets like "enterprising" "creative."

he attention given by Tiger and to the question of sex roles is part general attempt to apply ethological oning to the major issues of our s. Like other popularizers in this l, the authors of *The Imperial Ani* appeal to our sense of impending n and feel that they have direct line he truth, allowing them to bypass arduous paths followed by political rists and moral philosophers.

ssuming that an objective basis for ality can be found in the proper unstanding of our biogram, Tiger and proceed to indicate which of our intions are in harmony with our anmatures and which are not. Bureauy is an example of the latter: it arts our primate spontaneity and es our special talents for working in ll face-to-face situations. Our system rganized education is another such ogically repressive institution.

here is a certain attractiveness to notion that ethology can, as these hors claim, provide a scientific founon for the concept of natural rights. be sure, the female reader will feel a newhat lesser sense of exaltation at proclamation of a biological bill of ts when she realizes that it is essen

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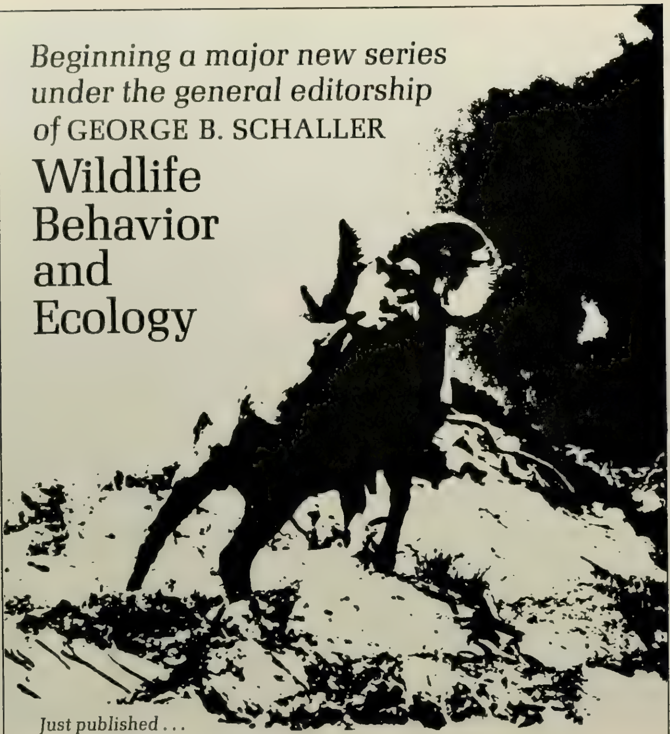

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The Spotted Hyena
by Hans Kruuk

tially males who are to benefit from
For the skills, talents, joys, and fr
doms with which Tiger and Fox are p
marily concerned are those of the hu
It is inhuman, say these authors,
men to live as peasants and bure
crats; it is a crime to turn them into
jects of exchange. Now, on the otl
hand, it is perfectly "natural"
women to be objects of exchange i
system of marital alliance. Since tl
are inherently more submissive and l
adventurous than males, we should
expect them to experience the sa
kind of frustration at routine and un
citing work. It becomes somewhat d
cult to sympathize with the degree of
dignation that Tiger and Fox exp
for the plight of their fellowmen. M
over, one begins to feel a cert
amusement at the way in which th
authors seek elaborate scientific jus
cations for their desire to get a li
more fun out of life.

In general, the moralistic pronou
ments scattered throughout *The Im*
rial Animal are not very far remo
from the homespun and often
tradictory beliefs with which we are
familiar. For example, the old no
that political inequality and exploita
are basic to the human condit
("there will always be black lin
sines," as these authors put it) is gi
the status of biological law by refere
to primate dominance patterns.
pervasiveness of liberal ideology, h
ever, is such that Tiger and Fox feel
liged to temporize on this issue.
one," they reassure us, "would m
tain the necessity of hierarchy. .
How are we to make sense of this
the authors are themselves confu
then they are guilty of a certain lac
forthrightness.

Professor Fox, in an article publis
in *The New York Times Maga*
(March 24, 1968) entitled "The Ev
tion of Human Sexual Behavior,"
had occasion to criticize others
have written about man in an ethol
cal mode. His concluding words, wh
are unfortunately all too appropriat
his own work with Professor Tiger,
a fitting ending for this review as
". . . if nothing else, I have put the
terested reader on guard against th
who seek to exploit the obvious inte
of this topic by offering intellec
shortcuts to solutions."

Judith Shapiro is an assistant pr
sor in the Department of Anthropo
at the University of Chicago.

ore
eviews

. Atlas of the Universe, by Patrick ore. *Rand McNally and Company,* *5.00; 272 pp., illus.* Astronomy, by nald Menzel, *Random House,* *7.50; 320 pp., illus.*

hese two latest entries in the "illus- rated books of science" market are pressive indeed. The use of the ab- viation "illus." in the bibliographic erences above just doesn't do them ice. How inadequate it is to describe illus. the book by Patrick Moore n, in fact, it contains nearly 1,500 s, illustrations, and photographs.

he two books have many sim- ities. Each is expensive, lavishly il- rated—and in color—large in for- t, manufactured with obvious cern for quality, beautifully de- ed, written by skilled and ex- enced authors, and packed full of as modern and recent as the publi- on dates indicate. But although re are great similarities between m, there are also enormous differ- es.

he Atlas of the Universe is an at- pt to present an up-to-date, atlas- compendium of knowledge about earth and the universe surrounding rawing as much as possible on data n astronomical research and from e exploration and technology. In it is unique; I know of no other k that has attempted this approach combined terrestrial and celestial s. As an atlas alone, it is unusual in enormous range of subject matter it ompasses, ranging from "The Evolu- of Life on Earth" to "The Search Life" (beyond the earth). Curiously, latter subject is taken up first in the k, when logic might suggest that it uld follow. The reason is to be found he nature of this handsome work.

atrick Moore has chosen to arrange book in five main sections. The first general discussion of astronomy space exploration, their methods objectives. The next four are "at- s" of Earth, Moon, the Solar Sys- , and the Stars (and the rest of the verse), respectively. In each of these major sections, facts, figures, and lanations are arranged within a

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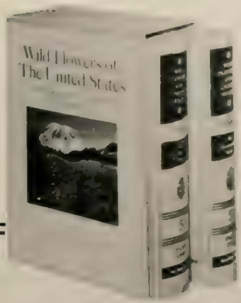

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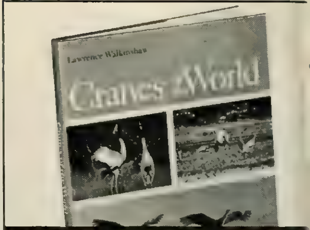
series of double-page spreads having a single subject title. In theory, all the data selected by the author on that subject is compressed into the double-page spread. Thus "The Evolution of Life on Earth" is one of the spreads in the section called "The Atlas of the Earth from Space," while "The Search for Life" is a spread in the first section of the book, "Observation and Exploration of Space." This is how and why we search for life beyond the earth (in this book) before we find out how and why it came to the earth in the forms we observe today.

As I said above, this book is unique in many ways. Sir Bernard Lovell, the eminent British radio astronomer, writes in the Foreword that "it is the first Atlas to draw together astronomical and terrestrial maps of the Earth as seen from Space, the Moon, the Solar System, the Stars, indeed the whole known universe into one volume." It is indeed, but it isn't always completely successful in accomplishing this difficult task. It just isn't possible to do so across the full range of topics it covers. On some, indeed on many, the book is somewhat mundane in its treatment. It has to be. After all, we cannot expect that every subject, every question will be best illuminated from the fields of space exploration and astronomy alone.

It is very difficult to find fault with *The Atlas Of The Universe.* The text and illustration labels are competently written, the illustrations excellent and pertinent. Its faults are so minor in comparison to the magnificence of the whole that they should not seriously enter into the thinking of the potential buyer. But there might be one bit of sound advice for the prospective purchaser. Don't buy it to give to a sick friend. He might not be able to lift it!

On the other hand, you might wish to give Menzel's *Astronomy* to a sick friend, or to anyone else who might enjoy a factual, well-written, authoritative, and well-illustrated reference to modern astronomy and its historical development.

Astronomy is arranged and written conventionally and places greater reliance on well-developed and logical order in its text. Its illustrations follow suit, always pertinent to the subject in the accompanying text, either explaining it or supplementing it. *Astronomy,* for example, takes up the origin and evolution of life on earth before discussing the existence of life elsewhere. It describes DNA in the text, whereas Moore's *Atlas* illustrates it in full color.



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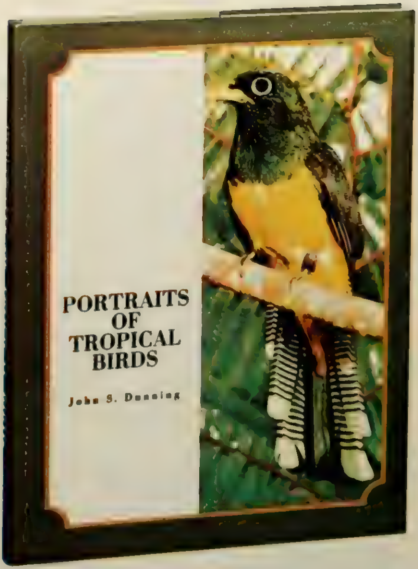

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ortraits of Tropical Birds is a rare achievement.

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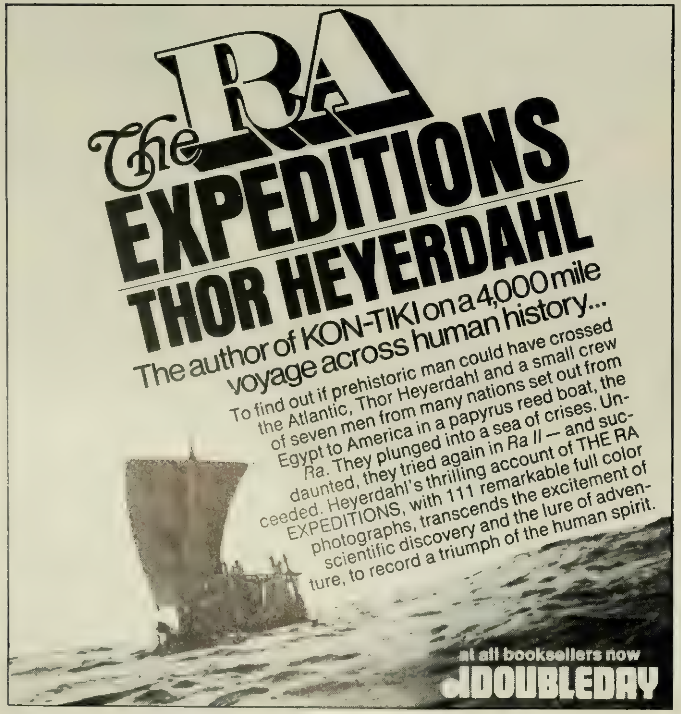

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and its significance to the story, bet
from Menzel's text than from Moor
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Donald Menzel's *Astronomy* is by
the superior text, and his position in
tronomy qualifies him far better th
Moore to write such a book. *Atlas*,
the other hand, covers a far grea
range of subjects, largely through its
lustrations and their extensive captio
but the text is not as significant as i
in *Astronomy*. Each is really intend
for a different audience and use.
tronomy is and can be a personal bo
one that you can enjoy reading a
treasure for reference. *Atlas* belo
exclusively on the reference sh
where its encyclopedic range of ma
rial can be found by those who hav
need for it, but you won't curl up w
it for an evening of literary relaxati
It just isn't that kind of book, rema
able as it is in other ways.

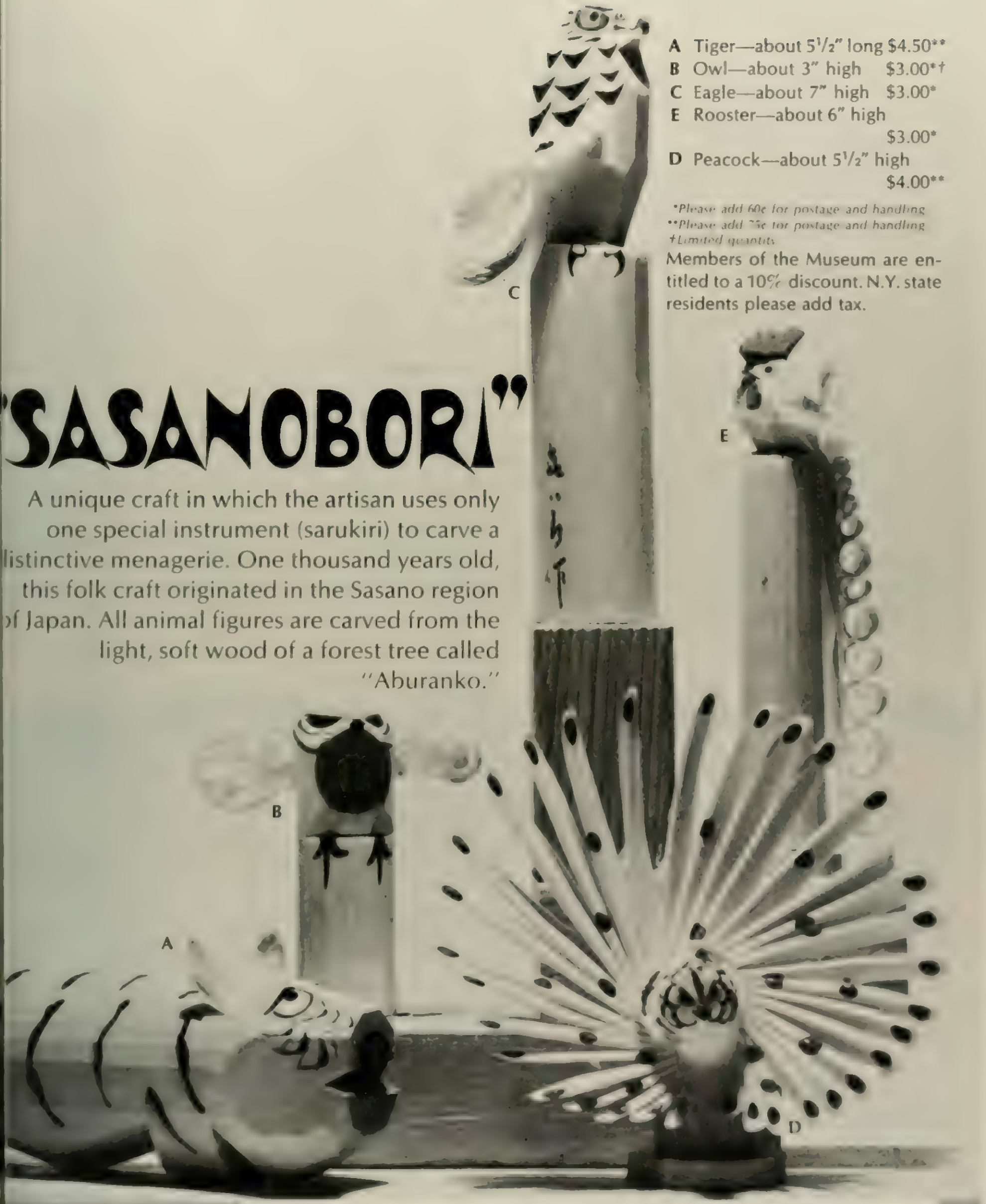
THOMAS D. NICHOLS
The American Muse

THE DEADLY FEAST OF LIFE, by Don
E. Carr. *Doubleday & Compan*
$7.95; 369 pp.

Man, like the rest of nature, lives
cording to the iron rule of univ
sal law, *eat or die*, a command that M
Carr, after looking at today's food a
poison equilibrium, amends to eat *a*
die, if not quickly and spectacula
then quietly and slowly. The plan of
book, its "literary architecture," as
author describes it, is to try to de
mine if man is a creature with a fut
by examining comparatively how a
mals, and plants too, use weapons of
fense and defense to "make a livin

Working up the food chain and
evolutionary scale from the protozoa
Mr. Carr finally arrives at man. Thi
the generalized animal who lacks cla
fangs, venom, powerful enzymes,
stingers, but who, using his large br
has created the chlorinated-hyd
carbon problem in the field of pe
cides, the food additive problem,
the dangers of atomic radiation, and
accomplished the degeneration and
phistication of his own natural food
in the case of chicken, which has b
made cheap but insipid by the
techniques of intensive animal
bandry.

The author, a retired petrol
chemist who has written several bo
dealing with the issues of human su



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Members of the Museum are entitled to a 10% discount. N Y State residents please add tax val, considers that *The Deadly Feast of Life* is neither a scientific treatise nor a tract. It is certainly not the first; but any writer who reviews historically the "stupendous catastrophes in both animal and plant phyla" and concludes that we are in grave danger of eliminating ourselves because of our uncontrolled technology and pullulating sexuality, has something, certainly, of the tractarian or prophet in his makeup. And does that require apology? Perhaps our greatest need is a fireman to ring the fire bell.

In any event, this is a very personal book, filled with indignation, frustration, irony, erudition, wry humor, all sorts of obiter dicta, often tucked in at the bottom of the page in unnumbered footnotes, philosophical reflections, and fascinating odd bits of zoological and historical information. Did you know, for example, that malaria may have caused the fall of Greece and Rome? Or that the skunk's defensive fluid when discharged at night is fluorescent and leaves a trail like tracer bullets? Or that male alligators roar when they hear sounds that approximate the B-flat two octaves below middle C played on the French horn? Or that one should avoid eating improperly cooked polar bear meat because of the risk of contracting trichinosis?

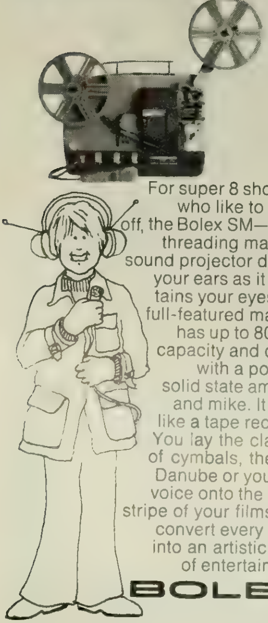
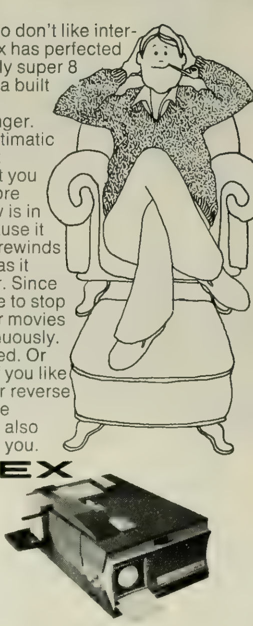
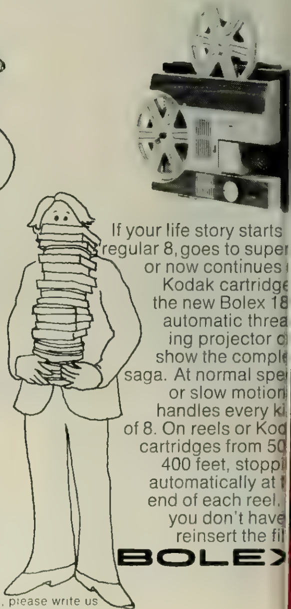
Mr. Carr has an informal style ("some zoologists don't buy this . . .") and also a fondness for the vocabularies of scientific and technical periodicals. His frequent reluctance to assume the translator's task constitutes a difficulty for the general audience he is trying to reach. However, despite such a sentence as, "Plants also may contain protease inhibitors (preventing protein digestion), hemagglutinins, goitrogens, cyanogens, saponins, gossypol, lathyrogens, favism-inducers, and so on," the author shows himself to be a dedicated zoophile and humanist, who hopes for the best but scarcely expects it. "What is so great about staying alive anyway?" he asks toward the end of his study. Whether this is an expression of deep despair or a bit of black humor each reader will have to decide for himself in the context of the book as a whole. The reviewer's opinion is that Mr. Carr is reaffirming the somber warning of The Preacher in Ecclesiastes, chapter
"He that diggeth a pit shall fall into i

GERALD CAR

ON THE SIDE OF THE APES, by Em
Hahn. *Thomas Y. Crowell Co., $7.*
320 pp., illus.

A report that baboons were be used in medical research on a erosclerosis aroused Emily Hah curiosity and imagination and star her on an extensive tour of resea centers where primates were being u as subjects. It wasn't long before her terest led her into the history of prim research, and a major part of this b recounts the trials and tribulations people who have worked with monk and apes.

Robert Mearns Yerkes, a man w great dreams and conviction, was outstanding figure in the early hist of primate studies in the United Sta Recognizing the need for laborato devoted to the study of animal behav with unflagging persistence he gra

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built one of the most important re-
h facilities in the country. His in-
ce on the development of primate
es far exceeded the work done
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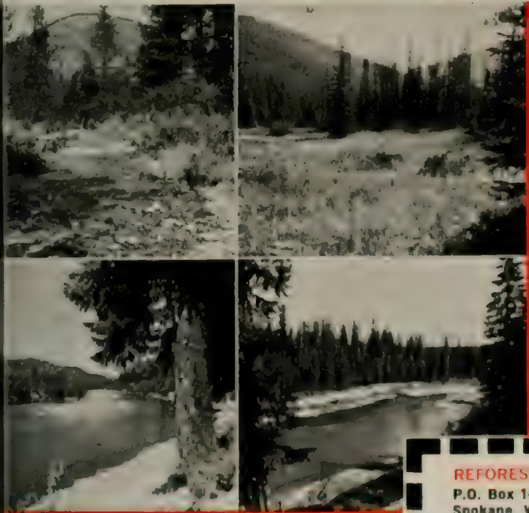
rch and teaching he stimulated
agues and students. Today the field
imate studies has grown to the ex-
that primates are important in such
se disciplines as medicine, an-
ology, psychology, and the space
ces.

was the behavioral similarity be-
n man and apes that led Yerkes to
d the chimpanzee as an important
atory animal, but chimps have al-
managed to capture human inter-
The behavior and personalities of
great apes make it easy to em-
ze with them—they are so much
humans in so many ways. Yerkes
not interested in amusing anec-
of chimp antics, however. He rec-
ed their value in research and was
ead of his time in seeing the need
formation from naturalistic studies
ucial supportive data for research
aptive animals. Progress toward
goals has not always been easy, but starting with the early field work of Nissen, a series of investigations, including those of Kortlandt, the Reynolds, and especially van Lawick-Goodall, have made the naturalistic behavior of the chimpanzee one of the best documented of any nonhuman primate species.

The existence of seven primate centers financed by the National Institutes of Health, six of them regional and one national, is a measure of the importance of nonhuman primates in research. Centers are located at "host" universities, and each has its own areas of investigation related to, but not duplicating, those of the other centers. The list of primate center studies is very long and includes topics ranging from details of social behavior to specialized studies of neurology, anatomy, physiology, and diseases. In many instances Miss Hahn resorts to long lists of technical topics to indicate the range of work at each location.

Other primate research facilities are described, including the "consortium of chimps" at Holloman Air Force Base, New Mexico, where a large colony of chimpanzees lives an atypical life on 30 acres of desert. Unfortunately, Miss Hahn offers very little background or comparative information about "normal" monkey and ape behavior. Patterns of primate behavior in a free-ranging social group are exceedingly complex, and primates require a context approximating the natural social setting and unit of the species for full development. The richness and space of a wild setting are seldom, if ever, reproduced in captivity. A valuable addition to the book would have been an assessment of causes and kinds of social deprivation in captivity and the implications of behavior deficits for behavioral and biomedical research.

A few chimpanzees have been raised with human families in attempts to teach the apes to talk. Emily Hahn surveys these valiant but futile efforts. The Kelloggs finally gave up their attempts to elicit speech from their chimpanzee, Gua, when she was 16½ months old—but only after monumental effort. The Hayes's famous chimp, Viki, entered their home when she was only three days old, but when she died 6½ years



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later she was only on the way to her fourth word. More recently the Premack's chimp. Sara, has been taught to use symbols of cut-out shapes of different colors. Washoe, the Gardner's young chimpanzee, is claimed to be able to use more than 70 gestures of the American sign language for the deaf.

Miss Hahn cites evidence indicating that chimpanzees cannot talk because they lack the anatomical structures for speech production. She omits, however, any reference to the evidence suggesting that the inability to learn to speak may be due to a lack of appropriate cortical structures that make possible cross-modal transfer of different kinds of information.

In addition to being a fascinating history of research on chimpanzees, this book offers the reader some unusual glimpses into the human side of research with monkeys and apes. The author presents amusing vignettes of the challenges primates present to human researchers. It is apparent that many researchers have a great respect for their subjects, although, at times, the latter do their best to foil carefully laid research plans.

The public hears many rumors about what goes on inside laboratory walls, and although Miss Hahn doesn't spell it out in detail, she does offer samples of the inside activity. She provides the reader a chance to share in some of the excitement, rewards, and frustrations of studying our closest living relatives. She also makes it clear that the applications of knowledge gained from these studies are often of life-saving importance to humans.

PHYLLIS DOLHINOW
University of California, Berkeley

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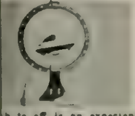

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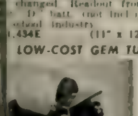

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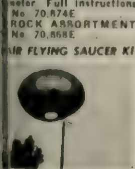

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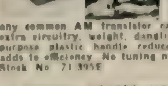

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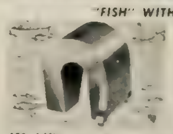

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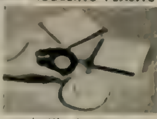

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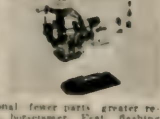

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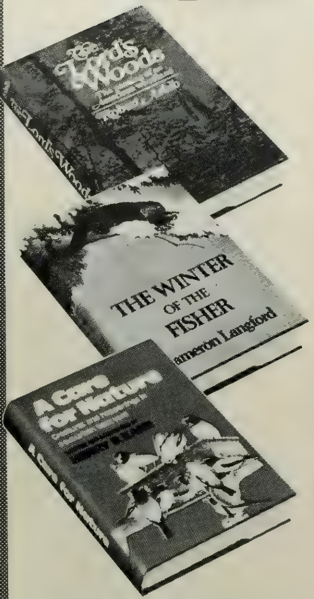

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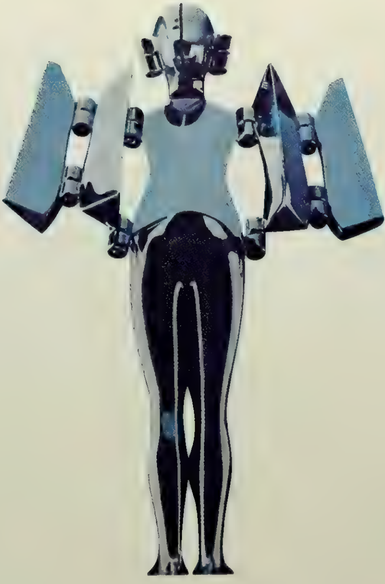
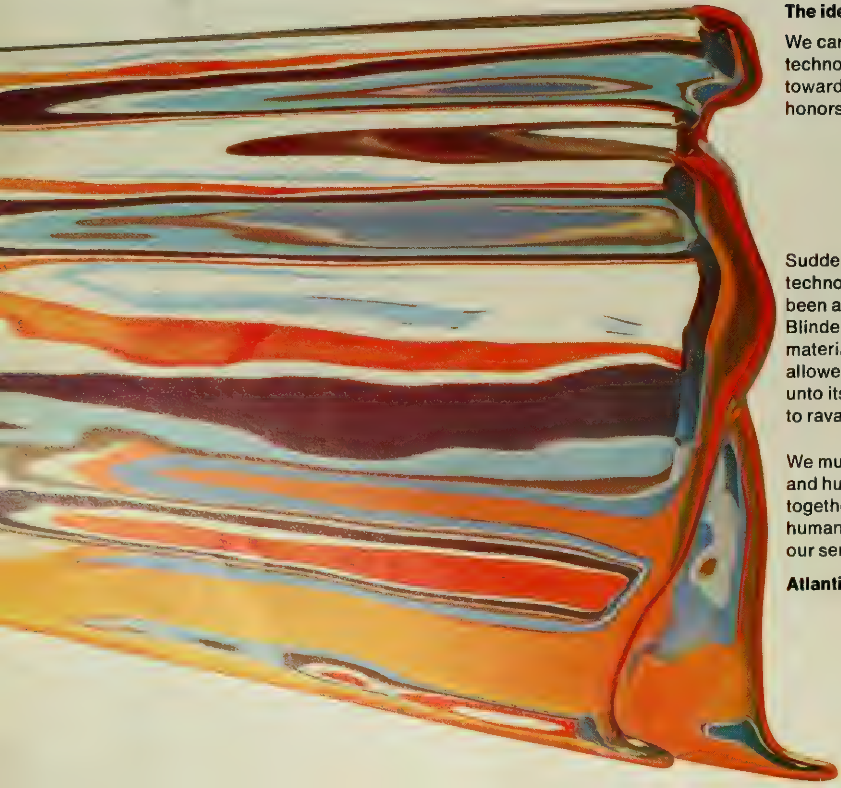


The real

Man has created a technology that distorts his humanity.



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INCORPORATING NATURE MAGAZINE

The Journal of The American Museum of Natural History

Gardner D. Stout, President *Thomas D. Nicholson, Director*

Vol. LXXX, No. 9 November 1971

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Manuscripts and illustrations submitted to the editorial office [illegible]

Authors

During the two decades of the gradual reappearance of Peking man, **Harry L. Shapiro** knew most of the major researchers on the subject and was personally involved in the charges and bitter feelings that arose after the mysterious disappearance of the fossils in 1941. Now he has uncovered some new information about the fate of these invaluable relics. Shapiro is curator emeritus of the Department of Anthropology at The American Museum and professor of anthropology at Columbia University.

Climbing the modestly elevated Catskill Mountains can be a heady experience for the urban neophyte. When Enterprising Enid enticed fellow New Yorker **Leslie Gourse** to join an expedition to the top of Slide Mountain, everyone got a little dizzy, except perhaps, Sly Sy the Bedroll. Gourse, a free-lance writer and novelist, serves as a stringer for the national desk of *The New York Times*, for whom she formerly worked full-time. On the basis of her novel, *Of Honey and Gall*, she earned a Doubleday-Columbia University Fellowship, which led to her bachelor's degree in writing from Columbia.

Old World archeology has b the chief field of interest of Wal **A. Fairservis, Jr.**, a research as ciate at The American Museum. has traveled extensively in cen Asia, the Middle, Near, and East, and following a stint in m tary intelligence in China, Bur and India during World War II, became Chinese Liaison Officer General MacArthur. Fairser whose research has centered u anthropological studies of the ra and cultures of Asia and c parative studies in early civilizati has led American Museum peditions to Afghanistan and Pa tan. Chairman of the Departmen Anthropology and Sociology at V sar College, Fairservis has a Ph in anthropology from Harvard U versity. His article is based on newly released book, *Costumes the East*, published jointly by Museum and Chatham Press.

The discovery of birth de-
mities among the terns on Great
l Island was due largely to the
rts of **Helen Hays**. Aided by

ss of volunteers from The
erican Museum, she has been
lying the colony in Long Island
nd since 1966. Chairman of the
at Gull Island Committee of the
seum's Department of Ornithol-
. Hays has also studied ruddy
ks in Manitoba, Canada; ibises
herons in Jamaica Bay, New
k; and terns in North Carolina.
holds a B.A. in conservation
n Wellesley College and au-
red "The Adaptive Ibis" in the

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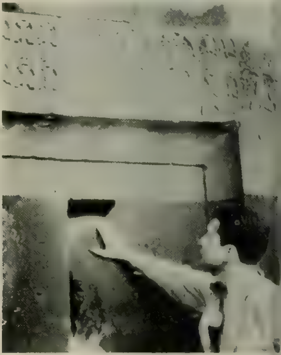
August–September, 1967, issue of Natural History Magazine.

Coauthor and investigator with Hays of the developing Great Gull Island tragedy, **Robert W. Risebrough** is an associate research ecologist with the Bodega Marine Laboratory of the University of California. He has conducted field work in the Indian Ocean, Southeast Asia, Latin America, the Galápagos, Antarctica, and the Canadian Arctic. Risebrough, a native Canadian, has a Ph.D. in molecular biology from Harvard University. He plans continued research on the effects of pollutants upon birds and marine ecosystems, including the terns in Long Island Sound. A more detailed report on the deformities discussed by Hays and Risebrough will appear in a forthcoming issue of *The Auk*.

William A. Dunson, associate professor of biology at Pennsylvania State University, has done much of his work on sea snakes aboard the *Alpha Helix*, research vessel of the Scripps Institution of Oceanography. His investigations have

concerned the successful adap
tions of snakes to a marine envir
ment and the reasons that oth
reptiles are not as numerous in t
sea. He is planning a sabbati
next year during which he w
study the physiological ecology
sea snakes at the Australian I
stitute of Marine Science. Duns
earned his Ph.D. in zoology at t
University of Michigan.

Charles E. Adelsen, author
"The Road to Ani," has team
with photographer **Henry Ange
Castrillon** for eleven years to
port on eastern Turkey in Europe
media. This article is the result
their second trip to Ani in sev
years, during which they fou
travel restrictions eased and m
tary commanders far more rela
about tourists. Ani is still not e
to get to, though, they add.



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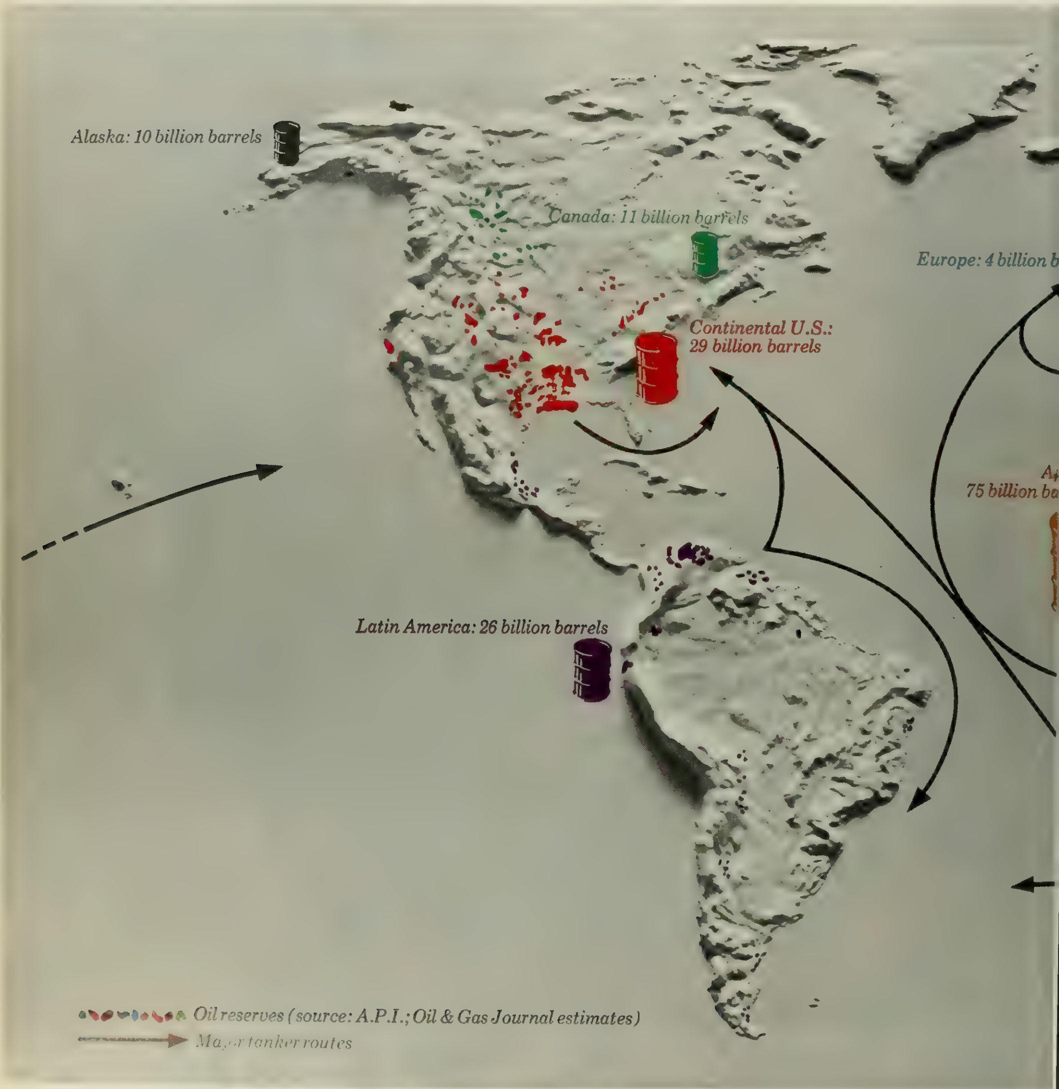
Alaska: 10 billion barrels
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75 billion ba
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Oil reserves (source: A.P.I.; Oil & Gas Journal estimates)
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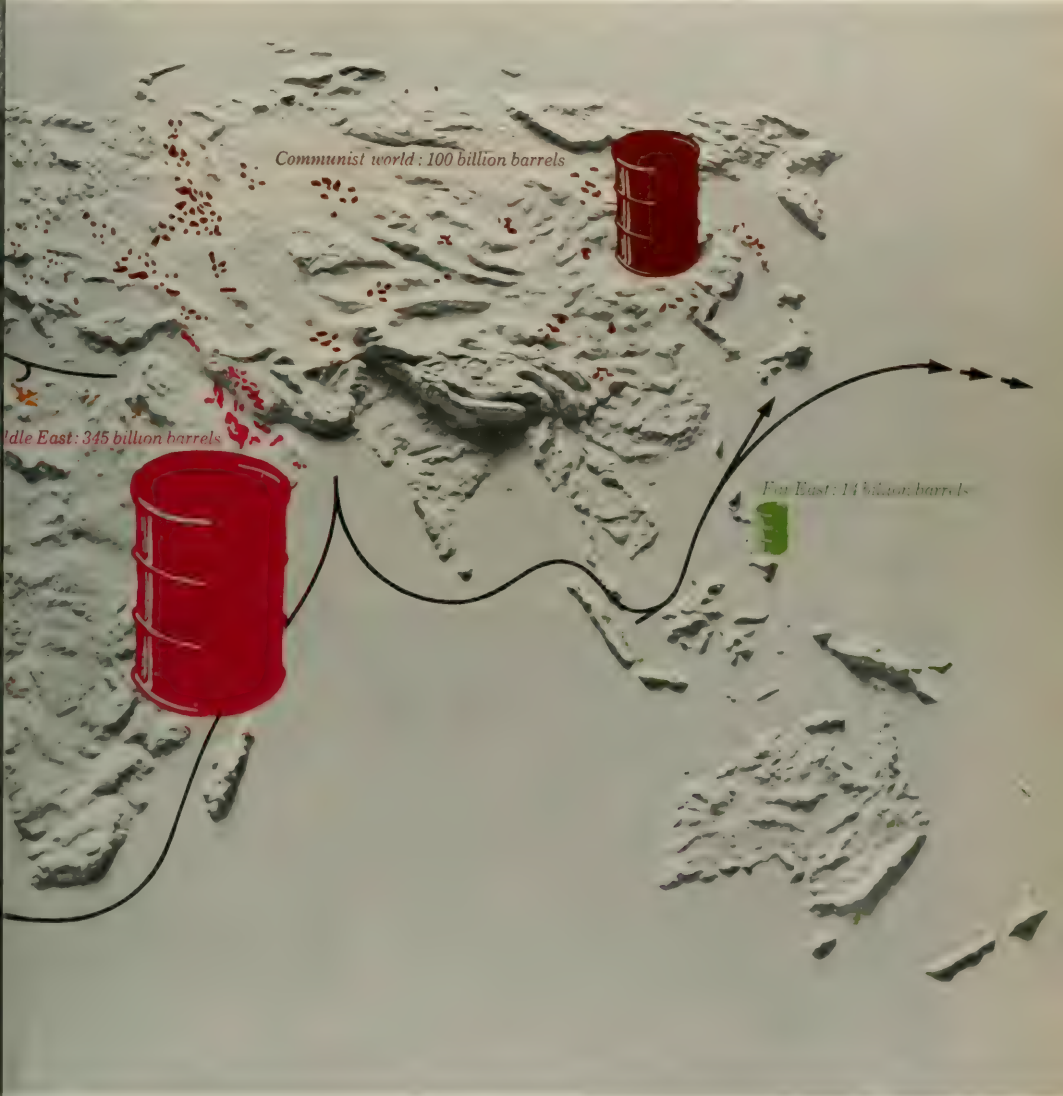
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THE STRANGE, UNFINISHED SAG

Politics, rumors, accusations, and the outbreak of World War II were all elements in the mysterious disappearance in mainland China of the fossil remains of *Sinanthropus.* These are some of the principal figures in this intriguing case, to which new facts have now been added. The fossils may emerge once again

McC
von Koenigswald

Ralph von Koenigswald, right, with T. D. McCown

Davidson Black

F. WEIDENREICH

Franz Weidenreich

F PEKING MAN

by Harry L. Shapiro

n 1941 Peking man dis-
ared. At least a half-million
s ago he had lived in China,
Peking. Like all other extinct
s of man, no tradition of his
er existence had survived
ng his successors, for "racial
ory" is no help in tracing the
rd of human evolution. And
, for a little more than a dec-
beginning in 1926, he made a
ual reappearance from oblivion
blaze of publicity. First, a
le of teeth, and later, bits and
s of his fossilized skull and
ton, until about 40 individuals
of this long lost population could be identified. As the fragments were found, they were widely and copiously reported in the press, the first time to my knowledge that so general and popular an interest had been displayed in the discovery of the traces of human evolution. Perhaps the Scopes trial had something to do with this, at least in the United States, for it was in 1925 that William Jennings Bryan and Clarence S. Darrow, with their arrays of distinguished authorities, had staged the last major public debate on the validity of evolution, particularly human evolution. As a result, the public was aware of the issue and receptive to fresh evidence relating to it.

In scientific circles the discovery of Peking man caused great excitement. In a short time he became the subject of a series of learned articles and papers, which quickly and firmly established his significance as an outstanding landmark in the hominid procession. For the Chinese, his relics took on the value of crown jewels.

The report from China in 1941 of the loss of these precious fossils

eidenreich, center, with a group of students from Peking Union Medical College.

spread rapidly around the world, particularly to those scientific centers where human evolution is of major interest. At first, it seemed incredible because since the publication in the nineteenth century of Darwin's *Origin of Species*, fossils—as the sole tangible evidence of evolution—had taken on a kind of sanctity. They were the rare fragments of the successive worlds of the past and the keys to understanding the forms that life took in its tireless and unending adaptation to the environment. And among these relics none had a more immediate interest than those that traced the course of human evolution. If an institution was lucky enough to own any of these fossils, it protected them with special care. Permission to handle and examine them was granted only to qualified experts. Since their scientific value had come to be recognized, there had never been such a disaster.

Nowhere was the loss more devastating than at The American Museum of Natural History. Here, Franz Weidenreich, the scientist then most deeply involved with Peking man, was writing his definitive study of the fossils. Since 1934, he had been studying them in China. Although Japan had been at war with China since 1937, in the summer of 1941 Japanese forces threatened to take complete control of the Peking area, and Weidenreich was forced to abandon his laboratory there and seek haven in New York. Reluctantly, he left the fossils in Peking. For at least seven years they had been his major, indeed his sole, scientific concern. The only physical, tangible records of them that he took with him were casts, photographs, and drawings.

The American Museum of Natural History was involved in another way with these famous fossils. In fact we may, in a sense, claim to have had some small share in the chain of events that led to their discovery. In 1921, the Museum's Dr. Walter Granger, chief paleontologist of the Central Asiatic Expedition organized by Roy Chapman Andrews, was in Peking. In that year he joined Dr. J. G. Andersson, a Swedish geologist associated with the Geological Survey of China,
a trip to Choukoutien, some
miles southwest of Peking. Gran
was not permitted to pursue any
dependent investigations th
since the Central Asiatic Expedit
had made an agreement with
Chinese government not to carry
any scientific work in North Chi

Andersson had made an ear
trip to Choukoutien in 1918,
this second trip with Gran
proved to be much more profital
A number of fossils of vari
animals were located, and a pro
ing site for further study and
ploration was identified. The p
pects were good enough to war
continued work. Dr. Otto Zdans
who was a young assistant to
Andersson, was assigned the tas
exploring further the resources
Choukoutien.

What led Andersson and G
ger to Choukoutien in the first p
is an interesting bit of paleontol
cal sleuthing. For years Europ
paleontologists had known that
likely source for the "discovery
fossils was the traditional Chin
drugstore where peasants sold

***Sinanthropus* skulls were discovered at a site (3) in the fossil-rich area of Dragon Bone Hill (2), southwest of Choukoutien (1). The Cenozoic Research Laboratory set up field headquarters nearby (4).**

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efore the name of Beethoven must all bow in reverence."
Giuseppe Verdi

le was ugly and half crazy."
Magdalene Willmann
In rejecting his proposal

he great musician of all ne."
Olin Downes
rmer N.Y. Times music critic

le has never learned anyng, and he can do nothing decent style."
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His music teacher in 1797

le was a Titan, wrestling th the gods."
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South America: Colombia, July 22; Amazon extention, one week; Ecuador/Peru, Aug. 19.

Europe: Scandinavia I, May 4; Ireland/Seminar, 2 weeks; Scandinavia II, June 14; Highlands and Islands, June 14; S. E. Iceland, 4 days; Iceland July 13; Balkans, May 25; E. Europe June 15.

Africa: North Africa, May 4; East Africa, Aug. 3; Central Africa, 2 weeks; South Africa, Sept. 6.

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"dragon bones" they found in their fields. In the Chinese pharmacopoeia, dragon bones were a standard item. Ground and powdered, they were prepared as specifics by the local medical practitioners. What the peasants did not know, and the paleontologists did, was that the dragon bones were often fossil fragments of extinct animals. As far back as 1901, Dr. K. A. Haberer had found a fossilized tooth in one of these drugstores, and it had been reported as human by Prof. Max Schlosser in 1903. But fossils discovered secondhand in drugstores have only a limited value since they lack the documentation needed for their orientation in time and association with ot forms of life. They are of use, ho ever, in suggesting to the expe that where they were found, ot fossils are likely to be discover for more precise reconstructio Choukoutien is only one of a nu ber of sites found by tracing drag bones back to their lairs. Ye later Prof. Ralph von Koenigswa a distinguished geologist and s dent of early man, found the mous *Gigantopithecus* molar te in a Canton drugstore.

While these preliminary vestigations were going on at Ch koutien in the early 1920's, th was a young Canadian in the wi ready to step forward and take

A skull, found in November, 1936, is prepared for removal.

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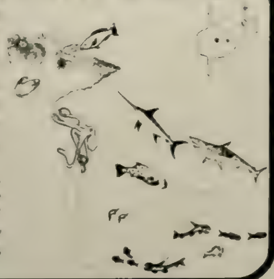

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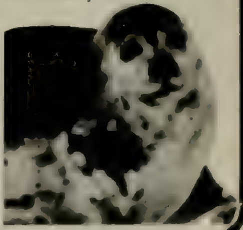

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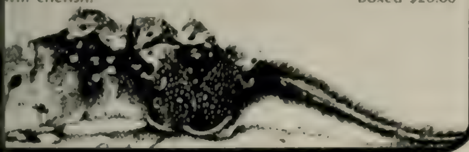

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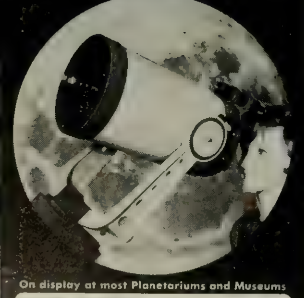

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leading role. This was Davidson Black, professor of anatomy at the Peking Union Medical College, one of the best known in China and one generously supported by Rockefeller Foundation funds. Interested in human evolution, Black was attracted to China because he had become convinced that it was a potentially rich source of fossil evidence for the reconstruction of the hominid odyssey through time. Black had already collaborated with Andersson in writing reports on the human remains found in several prehistoric sites discovered by the latter. And he had achieved recognition as an authority on human skeletal remains.

In 1926, things began to happen. Toward the end of that year both Andersson and Black announced a most unexpected discovery: two fossil teeth, a premolar (bicuspid) and a third upper molar, from Choukoutien were found to be unmistakably human. The teeth were in a collection of fossils sent by Andersson's assistant, Zdansky, to Uppsala, Sweden, for identification.

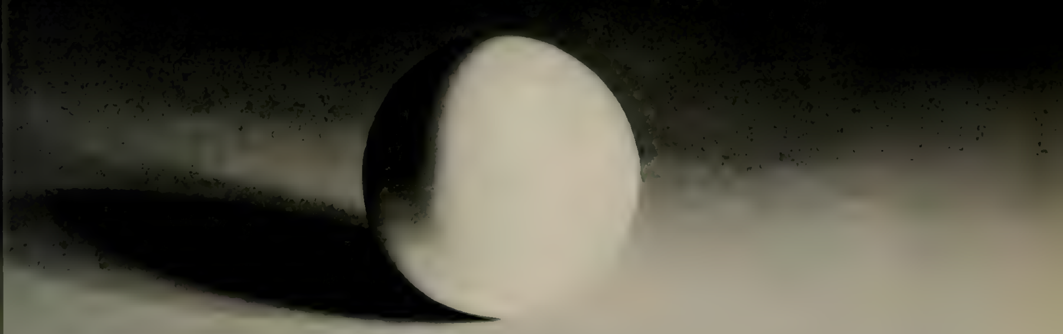
Black, in reporting the find in *Nature*, cited both Zdansky and A
dersson as placing these human r
ics in the Upper Pliocene becau
of their association with various
tinct mammals. This would ha
put man in China at least two m
lion years ago—at that time an
treme date for early man. But Bla
left open the possibility that the f
sils might be only from the ea
Quaternary, some one million ye
ago. He concluded, "Whether it
of late Tertiary or of early Quat
nary age, the outstanding fact
mains that, for the first time on t
Asiatic continent north of t
Himalayas, archaic hominid fo
material has been recovered,
companied by complete and cert
geological data. The actual preser
of early man in eastern Asia
therefore now no longer a matter
conjecture."

In that year—1926—the evider
for what was then called early m
was very sparse. Some thirty ye
before, Dr. Eugene DuBois h
found the skull cap and leg bone
Pithecanthropus erectus in Ja
The only other early hominid t
had come to light was *Austra*

Peking street scene, 1937.

the ultimate

[illegible]



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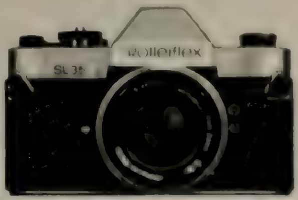


Rollei

...ultimately

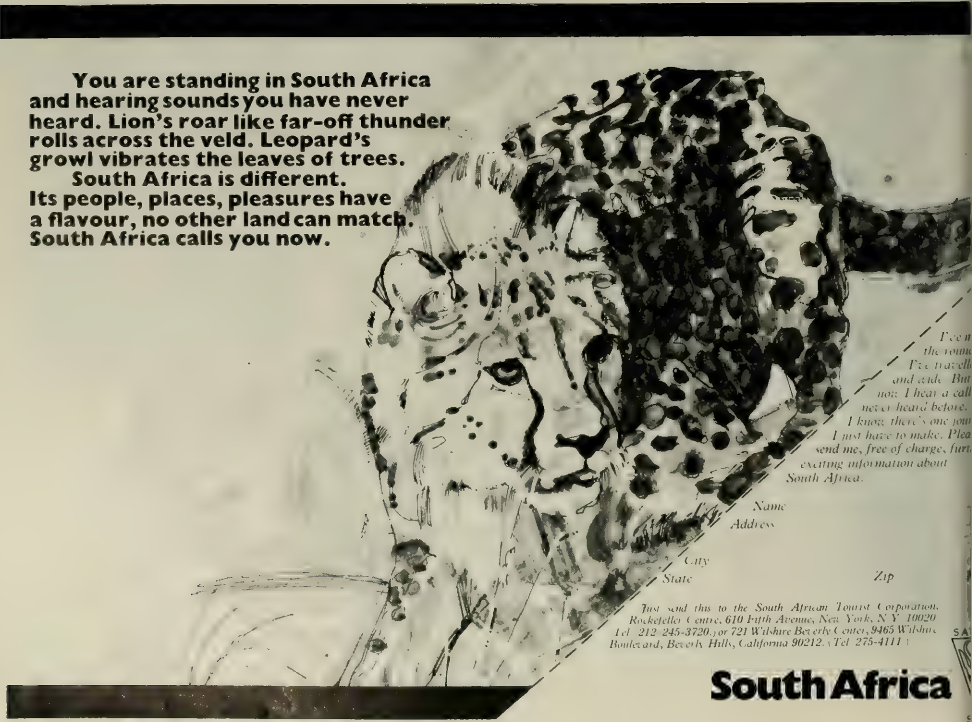
pithecus africanus, reported in 1925 from Africa by Prof. Raymond Dart. But its status was still far from clear. Many authorities were not yet ready to accept it as a true hominid. And even Dart, in spite of Robert Ardrey's much later reportage in *African Genesis*, was not altogether clear on the significance of his discovery. The very name he gave this fossil, *Australopithecus africanus*—the southern monkey from Africa—reveals his uncertain, even ambivalent, evaluation. Thus the appearance of early man in China took on a special significance.

When we recall the turmoil that was tearing China apart in the mid-twenties, it seems incredible that Chinese and foreign scientists were able to pursue their delving into the ancient past of this ancient nation. The war lords, who were battling each other and disrupting the life of the country, and the growing antipathy toward foreigners and their treaty ports, fade into a kind of irrelevant background to the drama of the discovery of this earlier population of man. While to many of the Chinese the digging at Choukoutien must have appeared as an unrealistic mania if they even knew of it.

Despite all this, in 1927 Black organized a systematic exploration of Choukoutien, which seemed warranted by Zdansky's discovery of the fossil human teeth. At the very end of this field season, another tooth was found. Black promptly announced its discovery and ventured to give it a generic name, *Sinanthropus pekinensis* (Chinese man from Peking), thus suggesting that it was distinct from other types of man. To some experts the evidence seemed rather slim for the reconstruction of a wholly new genus of man. But Black was in part justified by the discovery in 1928 of a juvenile skull that settled all doubts.

In the succeeding years new finds, many made by Black's assistant, W. C. Pei, came to light and greatly enriched the documentation of this new variety of man. In 1931, I visited Black in his laboratory at the Peking Union Medical College. I watched him meti lously cleaning newly discover fossils in a cloud of fine d sprayed out by the dental drill was using to remove encrustatio on the bones. After his tragic a untimely death in 1934, it was ported that inhalation of this d had contributed to it. Before died, Black published some repo on the fossils that continued to laid bare by the unceasing cavations, but the definitive studi were still in the future.

These fell to the lot of Pr Franz Weidenreich who was pointed in late 1934 to repla Black. Weidenreich, an int nationally known German scient who had made important contri tions in hematology and anato had later in his career become fa nated by the problems of hum evolution. He had written a rep on the Ehringsdorf skull, a Ne derthaloid skull found in Germa and various other papers deali with the problems of early man. 1934 he had left Germany, wh his Jewish origins would have



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South Africa

ne a hazard, to accept a visiting fessorship in anatomy at the iversity of Chicago.

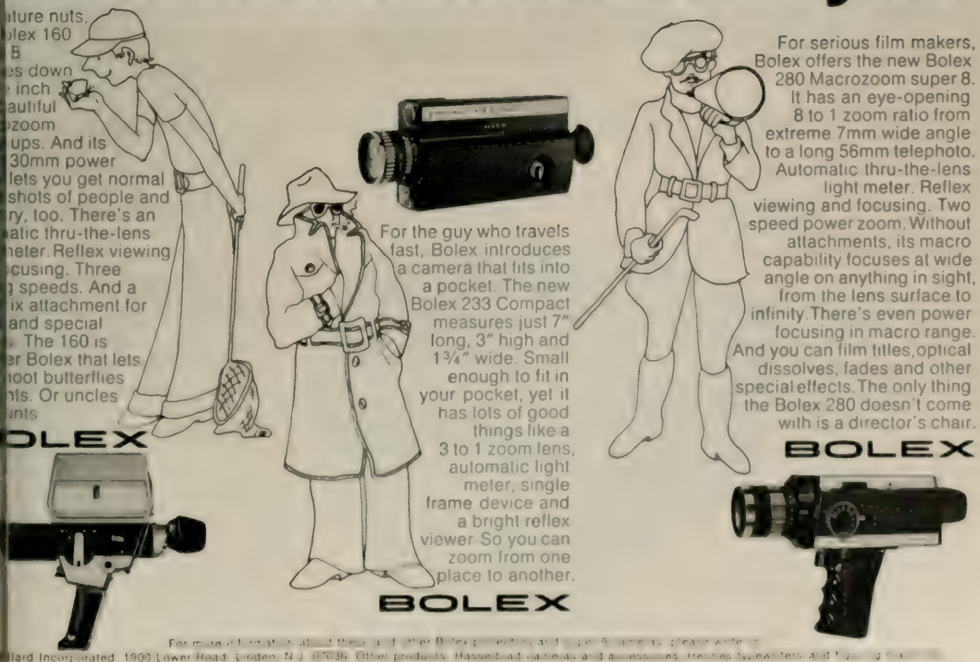
At the end of 1934, he was of- ed the post recently left vacant Black's death. The opportunity settle in Peking where he could sue investigations in the center is interests was too attractive to se. He took active charge of the ntific investigations at Choukou- until the Japanese occupation China finally forced a cessation all work at Choukoutien and iged Weidenreich to leave Pe- g and the laboriously accumu- d fossil remains of Peking man.

Why, one wonders, did not idenreich take the fossils with ? He knew that the Peking ion Medical College, where the sils were kept, had thus far es- ed Japanese raiding of its trea- es because it was technically erican property, and Japan and United States were not yet at . But the prospects for their fu- safety already looked bleak. record is clear that he was ply concerned with this problem. The options open to him and to the officials in charge of the Cenozoic Research Laboratory were these: they could put the fossils in a secret vault or some other hiding place in Peking, thereby avoiding the danger of shipping them out of a country in turmoil; they could dispatch them to some quieter section of China where they could be protected (Southwest China was such an area considered by the director); or they could send them out of the country altogether. Shipment to the United States was seriously considered. In a letter written January 10, 1941, to Dr. Henry Houghton, director of the Peking Union Medical College, Drs. W. H. Wong and T. H. Yin weighed the merits of the second and third choices. They concluded that in view of the practical difficulties of sending the fossils to the Geological Survey Station in Southwest China, it might be wiser to allow Weidenreich to carry them with him to some institution in the United States, despite the understanding with the Rockefeller Foundation that anything excavated at Choukoutien must remain in China.

A letter dated July 11, 1941, from Weidenreich to Wong summarizes a great deal of discussion and correspondence on the disposition of the fossils: "We arrived at the conclusion that it involved too great a risk to take the originals as part of my baggage. If they were discovered by the customs control in an embarkation or transit port, they could be confiscated. In addition, it had to be taken into account that the objects are too valuable to expose them to an unprotected voyage in so dangerous a time. Considering all the pros and cons, we decided, at least for the moment, it would be wise to leave the originals where they are now, that is, in the safe of the Cenozoic Research Laboratory in the building of the Department of Anatomy at the P.U.M.C." He went on to say that Rockefeller Foundation authorities in New York agreed, but that if conditions deteriorated further, the matter could be reconsidered.

I remember talking with

hat kind of a movie nut are you?



ture nuts, lex 160 8 es down inch autiful zoom ups. And its 30mm power lets you get normal shots of people and ry, too. There's an atic thru-the-lens neter. Reflex viewing cusing. Three speeds. And a ix attachment for and special . The 160 is er Bolex that lets oot butterflies ts. Or uncles unts

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Weidenreich on the matter, an recall that the decision not to r shipping the fossils in his priv baggage was made after he failed convince the U.S. ambassador a the commanding officer of the M rine Corps in Peking to send th out in official baggage. This wo have avoided the red tape of c toms regulations.

At any rate, nothing was do during those crucial months 1941. And Weidenreich left Chi taking with him beautifully p pared casts, photographs, and tailed drawings he would requ for the completion of his study Peking man.

The opus *The Skull of Sin thropus Pekinensis* appeared 1943. It was a major study and p vided specialists throughout world with a definitive descripti and assessment of this ancest population of man. When Bla first recognized and named Peki man, he identified it as a disti type of hominid living in the ea Quaternary or Pleistocene and was convinced that the populati played a role in the evolution *Homo sapiens.* As later finds a Weidenreich's study showed, king man certainly was primiti He had a brain capacity slightly der 1,100 cc., roughly 250 to 3 cc. less than modern man and ab 200 cc. greater than *Pithec thropus*, the only other early ho nid generally accepted at that tin The brain capacities of both *Pi ecanthropus* and *Sinanthropus* w well above the average for ap which ranges from 350 to 550 The form and shape of the skull Peking man showed traces of a like characters. The brow was l and retreating, with a heavy, bo ridge above the eyes. Althou much more capacious than that any ape, the skull was still, *Homo sapiens* standards, poo filled out and traces of ridges s remained. The jaw, too, was pri tive, lacking a true manlike ch The teeth, however, were definit human, with reduced canines a lacking the gap, or diastema, front of the upper canine where, ape jaws, the projecting canine the mandible can be fitted when t jaw is closed. Peking man, as e mated from his limb bones, w short—about 5 feet, 1½ inches.

Continued on page

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A Naturalist at Large

Up the Slide

Being the grueling account of the ascending wiles of Sly Sy and Burt the Body

by Leslie Gourse

Enterprising Enid the Fair packed lunch. I refused to do anything.

Well, I helped pay for the roast beef, cheese, cake, apples, and wine, which Enterprising Enid Moore, a very pretty, dark-haired, straight-nosed, oval-chinned director of publicity, promotion, and advertising for MGM-TV, told me the men would appreciate.

The men had invited us to take a hike in the country. The hike, which entailed going up Slide Mountain, the highest peak in New York's Catskills, meant climbing to an elevation of 4,204 feet. The prospect of lunch in that rarefied atmosphere did nothing for my appetite.

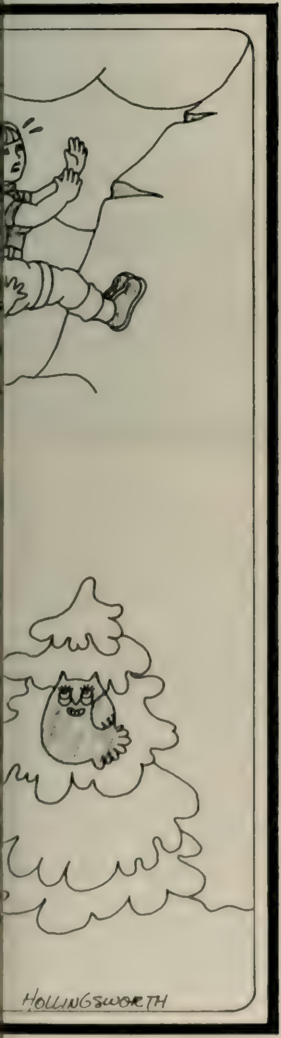
Upon hearing that I had tripped into a slough of despondency at the thought of such a dizzying climb, one of the men, Sy, Sly Sy the Bedroll, Bucholz, a lawyer, tried to reassure me:

"Sure you can do it," he told me by the walkie-talkie he had won in a two-year rock-climbing marathon now named for him in the Himalayan bazaars. "We start at 2,400 feet. It really isn't much."

"It's more than the Empire State Building," I said.

"It's supposed to be fun," said Enterprising Enid, who had once slept for a whole day after an eight-mile walk on flat ground. But even so, I wasn't inspired.

In fact, until the moment we chugged out of New York City in Sly Sy the Bedroll's car, named "Old Smokey" by those who knew her best, I was on the verge of dropping out of the party. In addition to Enterprising Enid, Sly Sy, and myself, there was Burt, the Body,



Greenberg, a six-foot metallurgical physicist Sy had met in Wyoming, who looked big enough to carry me. But when I first saw him, I didn't know it might come to that.

We drove north for three hours on the New York State Thruway to Kingston, then west for about 25 miles into Buckley country. Route 28 took us through Ashokan and Big Indian; then a final push south past Oliverea, the last wide spot in the road. From there, talk of former mates and the lovely roadside foliage having dropped off, we were all primed for Slide Mountain.

We parked Old Smokey on a narrow road overlooking a swiftly running brook: dark water dappled with bright coins of sunlight sifting through the trees. Enterprising Enid, wearing tennis sneakers, and I with chic, maroon, chunky-heeled shoes, were laughed at and even slightly cussed out for our footwear. Both men wore sturdy boots. I begged to be left behind in the car with a bit of food. Enterprising Enid didn't say much, as is her style at such times.

"We could take a more challenging route to the top of Slide," said Sly Sy the Bedroll, "up the Wittenberg-Cornell-Slide trail." That would have meant starting from Woodland Valley and climbing over 3,720-foot-high Mount Wittenberg and then over 3,880-foot Mount Cornell before starting up Slide. For the rugged, the view of the massive pile of Slide from the western shoulder of Cornell is a rich reward for the additional climbing time and trouble. But a climber named John Burroughs, in his first attempt to climb Slide by this route, got only as far as the top of Witten-

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berg. That, of course, was in the nineteenth century, when the Catskill Mountains were trackless forest. Now a network of trails allows climbers to reach any of the major peaks within a few hours. But one mountain a day was enough for Enterprising Enid and myself. We would settle for the view from the top of Slide, where we would see nothing as massive as what we were standing on.

Leaping across the rocks in the swiftly running brook with all the grace of arthritic packhorses, Enterprising Enid the Fair and myself trailed the men up a steep, muddy embankment about fifty feet high.

"I can't do this," I said, huffing and puffing and turning my ankles in my high-heeled shoes.

"Sure you can," said Sly Sy.

"Now comes the great moment when the elephant leaves the water," I said, pulling my shoes out of the sucking mud.

"What?" said Burt the Body.

Enterprising Enid laughed at me, then stubbed the soft toe of one of her tennis sneakers on a boulder. Sly Sy was carrying the picnic lunch, a camera, a flashlight, and that bedroll of his. We hit a level road, which seemed to wind up the mountain endlessly. A mountain trail. Blessed relief after fifty feet of steeply sloped mud.

"Okay," I said, pressing on. "This is more like it."

"We'll see spruce and hardwood trees for a while, until we reach the top of the mountain where the balsams are," said Sly Sy. "The top is the real treat."

It was a while along the trail—with trees, lichens, emerald green moss, and a watering trough with gourds for drinking the cold clear water that had only a slight residue of dirt in it—before we hit rough terrain. Rocks, big rocks, a mountain stream cascading over them, and thousands of soft, mushy, bright yellow leaves where the trail should be.

"What's this?" I said.

"That's the trail underneath all those big rocks, and that's a mountain stream cascading over them and thousands of soft, mushy, bright yellow leaves to cushion your collapse," said Sly Sy.

"I can't go any farther," said Enterprising Enid.

"Sure you can," said Sly Sy.

Enterprising Enid and mys
looked at each other. Then she to
Sly Sy's wiry arm, and I caug
hold of Burt the Body's wrist;
all started navigating the rocks a
the swiftly running mounta
stream. Enterprising Enid in
sievelike sneakers and I in my c
maroon shoes with the chunky hi
heels. This difficult trail continu
for a while, splendid to look at,
drear colors of the wet rocks set
by the bright yellow leaves swi
ming in the fresh churning wat
and without realizing it, Enterp
ing Enid and I became gradua
faint. Burt the Body lumbe
along surefootedly, as if he w
walking on a golf green, while
Sy was running up the rocks. R
ning up, shouting, "I'm a little
of practice. I should do this m
often." He was going so fast that
almost ran out of sight before
terprising Enid and myself co
yell "Hey!"

"Huh?" he called back, his vo
sounding distant like the fara
trickle of the mountain stream
ing strong hundreds of feet ab
us.

"We're going to sit down fo
while," I shouted.

Burt the Body said, "What?"

Enterprising Enid and myself
down for fifteen minutes on a
flat rock by the edge of the trail a
didn't move, although the men
treated us to.

"C'mon," Sly Sy said repeated

My legs and feet hurt becaus
kept turning my ankles. Enterp
ing Enid's feet were soaked a
tired, I gathered, from the first
guished look I had ever seen on
straight-nosed, oval-chinned fa
We did press on for a while mo
until Enterprising Enid and mys
holding hands tightly and laugh
hysterically, tears rolling down
cheeks and falling into the case
ing mountain stream, sank as
with one lost mind onto another
rock along the trail.

"I go no further," I said. "P
the lunch bucket."

By that time we were half
there, Sly Sy said. "The expedit
goes wider loose," he said, tr
lating directly from a phrase he
learned from a Sherpa guide.

"What?" said Burt the Body.

"How far is it altogether agai
I said.

"It's the highest peak in

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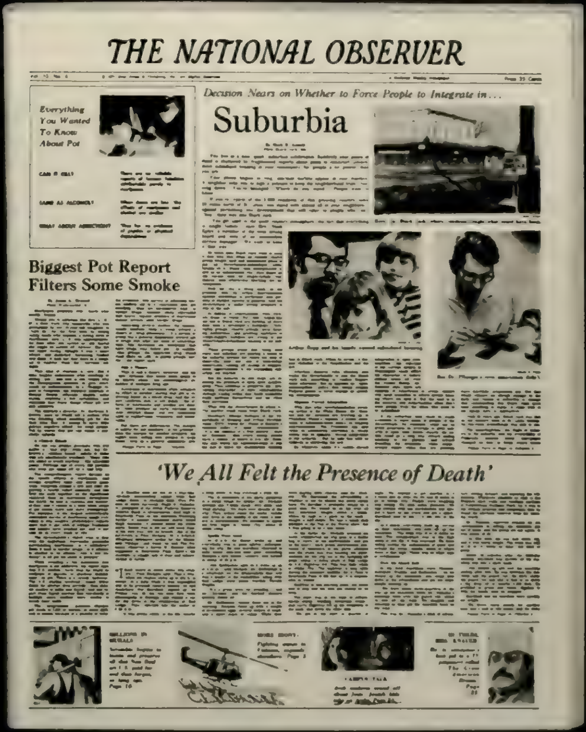

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Catskills, 4,204 feet high," said Sly Sy.

"How much is half?" asked Enterprising Enid, losing control.

I stuck my fingers in my ears to stop laughing, which is my own personal method. It's something I hadn't had to do since the morning I was caught standing on a balcony in a huge pair of men's pajamas by his elderly, multilingual aunt.

A middle-aged man in mountain-climbing gear passed us on his way down the rock and water trail. He smiled at us as we rested.

I asked, "Is it like this all the way up?"

He said, "Yup."

Sly Sy took snapshots of us to pass the time. After he did that, we felt rested enough to try a little more. So we wouldn't be a bad influence on each other, the men separated us, and the last I saw of Enterprising Enid for a while was Sly Sy pushing her from behind when she balked on a rock. Burt the Body purposely blocked my view.

It didn't take us but the whole day to get up and down that mountain. On top we settled on some hard rocks and looked at the enormous countryside we had plunged up from. It was very quiet. Soundless. A pale blue sky, clouds, dense dark clusters of trees on the sides of smaller surrounding mountains. Silent forests, somehow forbidding. And the odd feeling, for a long-time city dweller, of having nothing higher than my head in view. The men were exultant.

I asked for a telephone because I wanted to call a helicopter to come and get me, but there were no phones. Exhausted, I lay flat on a rock and nibbled at the sandwiches, fruit, cheese, cake, and wine with everyone else. Pretty soon everything was gone. In the clearing where we sat, the rocks were covered with the initials and dates scratched by climbers before us. Initials, twenty, forty, fifty years old. They must have brought hatchets with them to cut into that stone. All those people, with the climb becoming progressively easier as trails were blazed and marked so that even a novice wouldn't get lost, and no one had brought a telephone with him.

We peered into the endless depths of the sky, letting our eyes swoop down over the slopes and the empty spaces between the oth hills, and although I knew that would never see it again becau once was enough for me, I pe ceived that this expansive scene w very beautiful. Dark trees on th other hills blanketed the trails the and shielded any climbers, wra ping them in secrecy. A climb who had been resting on a ro near us in the clearing waved goo bye and started down the slop toward the dense forest on the ne mountain, where he would labor u to the summit, plunge into anoth valley, go up over another mou tain, and then down that last slop to a well-deserved rest. He was g ing the challenging way because liked to, Sly Sy explained.

It began to get chilly as the sk darkened. Starting our desce from the mountaintop, Enterprisi Enid and myself noted that our a kles wobbled, our knees shook, a our calves ached. The men had such complaints. I put on a pair clean, dry, white cotton socks to i sulate my cold feet against my w shoes.

Burt the Body urged us on, "Fo ward, men."

He supported Enterprising En and myself on our stumbling wa while Sly Sy the Bedroll ran ahea skipping down over the rocks wi astounding grace, hitting the roc lightly, perfectly balanced, like bewitching character in a childre story. After a while, Sly Sy slow down and supported Enterprisi Enid down the rocky trail, while let Burt the Body hold me up as feet skidded on the wet rocks b neath me.

Then one of us two girls had go to the bathroom, but she was t weary to go off the trail into the w derness with its thick undergrowt So our expedition had to leave t trail for a few minutes until that g relieved herself and the othe laughing hysterically, doubled almost unconscious on one of tho famous flat rocks. (I can't tell y which girl it was because Enterpr ing Enid is a very dignified perso

Further along, we refreshed o selves with water sipped fro gourds at the little trough and the within minutes, we were down. settled into the car, where I took my white socks, which were stain from the maroon dye of my ch shoes with the chunky high heel

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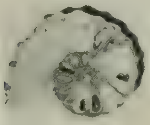

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and which now had the appearance of bandages left over from the Crimean War. And so it was over.

For thirty minutes we drove in comatose silence north toward Woodstock. Parking Old Smokey in the lot of the Joyous Lake restaurant, we went inside to eat thick, hot vegetable porridge, apple pie, and thick, hot coffee. The owner's wife, who was breast-feeding her baby at the time, sold me a hand-sewed suede miniskirt and vest for $35, paid for by check. Several well-fed cats purred around my ankles, avoiding my muddy shoes. Enterprising Enid didn't say a word throughout the porridge, pie, or coffee; she didn't even look at the suede vests, although for six months she had been talking about buying one for herself.

As we were leaving the Joyous Lake, I told Sly Sy he could drop me off in Woodstock the next time he wanted to get me near a mountain. Enterprising Enid giggled weakly as Sly Sy said, "Tell the truth, wasn't it wonderful?"

Driving home, nobody talked much. Enterprising Enid had a little sleep.

"What happened to everybody?" said Sly Sy.

"What?" said Burt the Body.

"I'm saving myself for the ten-step climb up to my apartment," I said dirgefully, my feet swathed in road maps. But Burt the Body escorted us to our doors.

Enterprising Enid fixed herself up and went to a party that night. I fell asleep in the bathtub the way my mother used to when she had spent a full day with me before I started school.

Sly Sy, who has a very bright and positive attitude toward mountain climbing, which he does on weekends and vacations, told us later that he wouldn't take us again. However, if we wanted to go back on our own, we could get booklets on the Catskill and Adirondack Mountains from the New York State Conservation Department's Division of Lands and Forests, complete with a map showing marked trails, public campsites, fire towers, and villages. And we could get detailed road maps for getting to the mountains from any gas station. So I sent all this material to Enterprising Enid anonymously as a practical joke, so she wouldn't readily forget
the outing she insisted I go on wi
her. Every once in a while she wo
ders aloud how the material came
her. I theorized that the State Poli
may have found some of her blo
on a rock, but she says she cann
remember losing any. She is not t
clear about it, however.

From time to time, we get po
cards from Sly Sy as he trav
around the country, climbing in t
White Mountains of New Ham
shire, the Tetons in Wyoming, t
Canadian Rockies, and now a
then in New York's Catskills a
Adirondacks. He says his routes a
nothing like the grandmotherly tr
we took up Slide. In the Tetons,
did technical rock-climbing wi
ropes. He particularly likes clim
ing in New Hampshire, whe
things can get very alpine and the
are strong winds and you can g
killed. When he climbed Mou
Washington there recently, he to
a girl with him. It was a 4,000-fo
climb to the top, where it was
clouds and wind. "The girl made
but she was a wreck," wrote Sly S
"I didn't know if she was going
be able to drive us home."

More and more good climbe
are going to Alaska and Peru,
writes, and he hopes to go, too, b
cause there are challenging rock
ice and snow, with high-altitu
peaks and year-round glaciers. Y
semite, too, tempts him because
has big wall climbing. Along wi
the Tetons, the Sierras, the Whi
Mountains in winter, and Colorad
Yosemite makes for some of t
most exciting climbing in the U.
he says, with some very "hair
ice-climbing for people too jad
for rock-climbing.

He sends one postcard address
to Enterprising Enid and myself
her MGM-TV offices to save po
age, because he is saving up for
victorious hero's homecoming
the Himalayas, even though
makes his parents, retired groce
in Brooklyn, rather nervous.

Enterprising Enid and I are pla
ning to go on a picnic lunch at t
foot of Slide, where we will sh
our sedentary boyfriends—who s
dom walk farther than across the
offices or at most a few blocks—t
muddy embankment and the thi
trees at the base of the mountain
climbed. It has become a source
pride. Enterprising Enid laug
when I tell her that.

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lot all fishes live only in the water. Walking catfish, mudskippers, lying fish and many other species hunt on land or in the pen air. Normal fishes are myopic out of water, but the amphibious nes — like the bulging-eyed creature above — have special yes allowing them to see through the air. In his fascinating article n FAUNA, Dr. Jeffrey Graham of the Smithsonian Tropical esearch Institute shares his discoveries of how amphibious fishes an see. And his vivid illustrations, including close-up photos, re superb. But fish vision is just one of the exciting new discoveries eported in FAUNA. There are many more in every bimonthly issue.

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COSTUMES OF THE EAST

Clothing means more t people than mer protection from th elements. Traditiona Asian dress, threatene by the proliferatio of relatively dra Western styles, reflects wellspring of cultura diversity and a wide ranging aesthetic jo

by Walter A. Fairservis, Jr

Some years ago a special exhibition on the arts of ancient Peru was held at The American Museum of Natural History. The lovely, masterful, and infinitely colorful metal, pottery, stone, and fabric objects on display represented the cultures of civilized and aboriginal Peru before the white man. The opening of this splendid exhibition was attended not only by representatives of the Museum, the press, and the city, but also by members of New York's social and business elite. The men wore business suits, all cut approximately the same way and made grave by the shades of gray, black, and brown conventional to the modern American male. The ladies, conscious of current fashion, wore dresses that differed slightly from one another in cut, but almost all shared one color—black. Most of these dresses, regardless of design, were adorned by strings of pearls.

The appearance of modern man as represented by this sample was funereal and conformist. When one considers how many individuals in this group commanded wealth and power suitable to the ambitions of past monarchs, the factors that created this costuming must have been stringent indeed. These people, as well as most urbanized citizens of the West, are heirs to the whole colorful tradition of costume that runs from ancient western Asia, through *Godey's Lady's Book*, to the current French fashion mart. There was, and is, no reason why this incredible resource in history could not be drawn on to produce variety in the costumes of modern man—except for limitations imposed by cultural conventions.

Costume is basic to man's culture and is as much a part of his natural history as the courtship dance is to the ruffed grouse or social behavior is to the African lion. With its vast variety of form and ornament, costume provides the anthropologist with a graphic choice for sorting out the ethnic, occupational, and social categories to which individuals of the species *Homo sapiens* belong.

Conventions of dress have always been rooted in the value system, the technology and economics, and the communicative aspects of one's culture. Until recently, whether you worked on Madison Avenue or on New Bond Street, wearing a pair of bright red socks or an emerald green tie to the office might have provoked a barrage of joking remarks. Costume deviations have, in the past, even led to circumstances in which an individual lost his job. While attitudes today are somewhat more relaxed, conformity is still the general rule.

One manifestation of today's youth revolt is costume. Barefooted, long-haired young men will wear T-shirts and dungarees, African shirts, or Asian costume jewelry so that they may be in direct contrast to the establishment exponents of Western cities and towns, with their shirts and ties, coats, pressed pants, and shoes. Their female counterparts present similar contrasts. Ironically, however, once the rebellious generation establishes its costume conventions, it adheres to them as rigidly as does the "other" generation. Costume on either side of the generation gap is now so conventional that little of the unexpected is found. Indeed, Western man appears to have decisively limited his costume repertory to what is conformist, generally drab, and

The traditional embroidere cotton garment of the Banjar women of Hyderabad, Indi closely resembles Europea gypsy costumes, fosterin a belief that gypsie may be descendan of certain Asian people

icient. In part this is the result of mass production of inexpensive thing, but more important, West- n man candidly admits he likes clothing that way.

One may ask why this is so, for if present costumes of Western in are the end result of the cul- al evolution that created West- n civilization (and we have no son to think that the devel- ment of costume is divorced from it evolution), then conformity in dern costume is perhaps symp- natic of conformity on a deeper d more meaningful level. From scow to San Francisco most men d women wear the same kind of thes, varying only slightly from norm according to occupation wealth. The Japanese, Chinese, d urbanized inhabitants of South- st Asia, India, western Asia, and rica have also adopted this type clothing, as have Australians and st Latin Americans. All who are volved with modern indus- lization and its expression in the duction and control of goods l services, whatever their nation, ar the same basic costume.

Costume is unique to man. But does he wear clothes at all? Over-all dress may have evolved as *Homo sapiens* lost his presumed hirsuteness toward the end of the Pleistocene, or as his peregrinations brought him from warmer climes to more arctic ones. But man is wonderfully adaptive biologically, and there is no reason to believe that he could not have retained relative or even absolute nudity through natural selection under different climatic conditions.

It is possible that the first clothing was worn simply to cover the vulnerable genitalia and other specific areas of the body. The genitalia of both sexes, as well as the female breasts, are highly sensitive; thus, it would seem sensible for man to provide artificial protection for these parts of the body. Furthermore, even among surviving aboriginal peoples, both the excretory and menstrual functions are regarded as antisocial. Concealment of the organs of such functions appears to be the result of this attitude.

Critical to our understanding of the character and role of costume is, of course, man's attitude toward sex. It has been said that costume should be regarded, not as the concealer of one's sexual character, but rather as its revealer. Too many in the West regard the genitalia, rather than the men or women who possess them, as the symbols of sex. Oddly, as students of erotica well know, the simple exposure of genitalia is not as erotic as the partly clothed body. The difference between the sexes is not simply a matter of plumbing, but in its ideal sense, a matter of the whole person who possesses a form of body and a state of mind that complement or supplement the opposite sex. It is a mutuality that transcends biological identity, and yet in its fullest expression emphatically identifies the individual as a woman or man. One's culture determines what is masculine and feminine by a whole pattern of attitudes and behavioral emphases that have to be under-

A Chinese theater costume
of Mandarin type made
of crisp silk with silk
and metallic-gold embroidery.

is overgarment of reindeer
in, decorated with tassels and
ndants of fur and bits of
tton, was worn by a Yukaghir
aman of northeastern Siberia.

stood within each cultural setting, for they are by no means identical from culture to culture.

All this suggests that the development and enhancement of those traits that graphically distinguish maleness and femaleness have been critical to *Homo sapiens*. In this, certainly, ideals of beauty have an important role. Body painting, tattooing, sweet scents, athletic or dance exhibitions, vocal expression, and the wearing of flowers or certain animal pelts have been among the graphic enhancers of one's sexual identity. Costume was, and is, a firm supporter of this identity. The recent vogue among Western women for men's clothing may be part of their drive for parity with men.

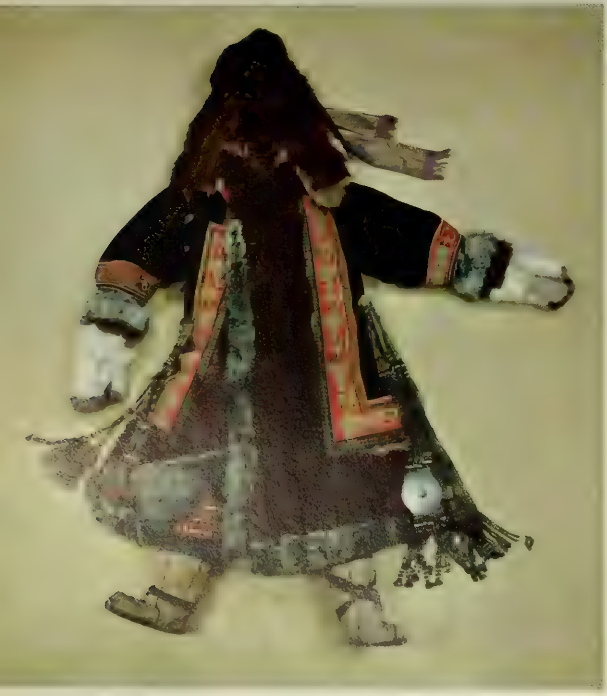
Whatever the early social forms of man, whether band or tribe, the identification of one's group through graphic representation is so commonplace among all peoples, past and present, that we can assume it was a part of prehistoric life. Here, costume, whether in terms of horned headdresses, painted skin robes, or adorned fur pieces, certainly had its place.

The Eurasian and North African region saw the beginnings of civilization in the latter part of the fourth millennium B.C. These early civilizations of western Asia and Egypt were heirs to rich weaving traditions that were already at least five thousand years old. Animal hair and a variety of plant fibers, including flax, were spun and woven, and dyeing seems to have been on the scene as early as 6000 B.C. The woven cloth was basically used as a wraparound or drape. This elementary, yet practical, form has characterized the garments of the Mediterranean, North African, and western and southern Asian regions until comparatively recent times. Early and elaborated expression of it can be seen in the arts of ancient Egypt and western Asia.

Tailored clothing appears in the historical record from about 2000 B.C., but it probably emerged earlier than that, as the sewed skin robes of the late Stone Age in Europe suggest. However, to both central Asian pastoralists and arctic hunters, pants and sleeved shirts had obvious advantages over the draped garments of the more southerly peoples. Pants allow for free movement of the legs, while insulating the flesh from weather and wear.

Thus we find that by the time of Christ, the peoples of the Mediterranean world, the Near East, India, and China wore varieties of draped clothing, skirts, pullovers, and wraparounds, while the peoples of central Asia and Europe beyond the Mediterranean realms wore varieties of pants and skirts. The latter group made their clothing largely from wool and animal hair; the former used cotton, linen, and silk. Not that these softer materials were unappreciated by the people of Europe and central Asia; rather, they were difficult to obtain since they had to be imported. But there was another, perhaps equally basic, reason.

Both the ancient Egyptians and the Chinese had strong feelings about wool. Those who wore the



For harsh Siberian winters, a Yakut woman wore a costume made of furs and wool flannel. This one is embellished with silk and gilt embroidery, silver pendants, and a variety of pouches.

Dragon robes, made in China for nearly one thousand years, can be used to trace the progress of certain dynasties by noting distinctive features of design and the quality of workmanship. This detail is from an actor's costume of recent years, used for the role of emperor.

rough material were regarded as "barbarians" outside the pale of civilization. In turn, there are records of Europeans and central Asians contemptuously remarking on the effeminate silken clothing of "civilization." To have a beard and to wear wool was to be a barbarian or a bandit in the eyes of the Chinese. To wear silk and be clean-shaven was to be weak and unmasculine in the opinion of the Turk. In such ways clothing marked the cultural affinity of people in ancient times. The idea that draped clothing is effeminate and tailored clothing masculine is still found in such remarks as the one supposedly typical of a family dispute: "Who wears the pants in this family, you or I?"

The history of Western costume is comparatively well known and can be found in many fine books. What is apparent in these histories is the rapid change in the costume of the European elite almost century by century. The costume of the peasantry, which formed the largest portion of the population, changed slowly—until the nineteenth century. Anthropologists recognize two complementary traditions in civilization: a "great tradition" carried by the overriding national, usually urban institutions such as government, church, the military, and business; and a "little tradition" expressed through local traditions and beliefs and often referred to as the folk order. Folk orders tend to be conservative, preserving elements of cultural styles for an astoundingly long time.

While the everyday costumes of the peasantry were generally designed for the ease of movement required by farming, and were correspondingly simple and utilitarian, the clothing worn for church, for festivals, or for weddings, styled by centuries of tradition, was colorful and locally distinctive. Such costumes can be seen in the folk museums of Europe and, rarely, on festival occasions in a few "unspoiled" sections of that continent. However, this does not mean that the local tradition of costume is nearly dead, for among the many ethnic groups of Europe that claim a degree of autonomy, costume still has nationalist meaning.

The finest folk costumes were made at home or by the best seamstresses in the village or district. They were prized possessions, carefully stored, cleaned, and mended. Often the combination of intricate sewing, painstaking work, and pride in the result produced a work of art as precious or, indeed, more precious than the products of the weavers' guild in the courtly cities. Such costume treasures were characteristic of much of Europe's folk culture. Into the creation of these costumes were fed the traditional symbols, the colors, and the iconography that marked the folk belief and gave meaning to the end result. When a peasant girl appeared in her traditional costume she emphasized her pride in tradition and her identity with it. What she wore, when she wore it, and what she did while wearing a given costume derived from centuries of tradition, not in a stultifying sense (for the pragmatic peasantry rarely burdened itself for long with the stiff collars, high pantaloons, and agonizing corsets that the aristocracy forced itself to endure in history), but in a very personal and often mystical sense.

What one wore reflected the spirit of the past, the reality of the present, and the hope of the future—a future that would see one's children doing the same things as the parents. It is this personal, tradition-bound quality that marks folk culture generally and that has to be understood if one is to ascertain the true motivation for folk costume.

The personal and the traditional characteristics of the little tradition contrast markedly with the impersonal and style-conscious character of the great tradition. The bewildering changes in the history of Western costume reflect the political, social, and economic fortunes of the elite and their supporters. Class consciousness, individual accomplishment, patriotism, wealth, and occu-

In nineteenth-century homes in Aydin, Turkey, women wore dresses of satin brocaded with metallic-silver floral patterns. Out-of-doors they donned a cloak and veil according to Moslem custom.

pation strongly influenced members of the institutions of the great tradition. One can detect the concern of the time in costume development, from the wealthy ostentation of the Renaissance courts, through the imperial classicism of the Napoleonic era, to the stamped-out conformity of the twentieth century. International contacts, political events, a theatrical personality, war, the state visit of a dignitary, the automobile, a new dance—all have contributed to changes of costume style. The plethora of Asian- or African-derived fashion elements, which the Westerner eagerly placed in his costume repertory and as eagerly discarded when it was "out of style," bewilders the mind: burnooses, turbans, kimonos, saris, Tartar hats, caps, pajamas, sandals. Napoleon revived the styles of ancient Rome—and some famous personages wore togas; while late in the nineteenth century Donizetti's opera *The Daughter of the Regiment* put fashionable women into fashionable uniforms. The discovery of Tutankhamen's tomb in 1922 had American women dressing like Nefertiti; when Walt Disney did "Davy Crockett," coonskin caps swept the nation. Beau Brummell, Greta Garbo, Tarzan, Grace Kelly, the Beatles, and many others have caused widespread costume change.

The great traditions of costume in Asia are not, of course, like those of the West. A tendency prevails in Asia to observe a tradition of costume rather than to change according to "style." Richness, history, and religion are major factors in Asian elite dress. The gold and silver saris of Benares, the Tartar-style cap said to have been worn by Genghis Khan, and the green turban of those who have made the pilgrimage to Mecca are examples. Asians have always put great stock in the symbols of faith, heritage, and princely wealth.

However, the folk order is yielding before the massive assault of modern industrialization and its spokesmen, the mass media. National states that link their future to standardization at every level, to the conditioning of their citizenry to one body of laws, to one political theme, to one educational philosophy, and to mass values regard the folk order as not only backward but inconceivable in an age when jets span the earth and man walks on the moon. So resentful of the folk order are national states that deliberate efforts are made to undermine its hold by subverting its youth, "modernizing" its traditions, and deriding its faith. National states thus obtain their goals—one nation, one people, one government, one belief, and of course, one costume repertory. The exponents of change through time overwhelm the exponents of tradition. Western costume is covering the earth.

This conformity of appearance, with its roots in conformity of culture, confronts Asian people as they look to the West and accept Western ways. The almost infinite and kaleidoscopic variety of Asian cultures is already being extinguished by the massive onslaught of the West. China, for example, once one of the most varied and colorful of all Asian cultural forms, is now one of the most conformist and colorless of Asian cultures. And if the present governments of India and Iran have their say, cheap, machine-made cloth and national "cottage" industry styles will become the manifest destiny of every citizen, no matter what his belief, his cultural heritage, or his income. This in the very lands from which sprang the splendors of design and craftsmanship that have ennobled mankind since early civilizations arose there thousands of years before the first smokestack darkened the skies of the West.

The great hope of the earth is that the proponents of Western culture can be made to consider not only the vulnerability of the physical earth but also the mortality of man's cultures. The reality of this mortality is made graphic in men's costume.

aris of silk with metallic
rocade, such as this example
rom Maharashtra state,
ndia, were popular in
he ancient city of
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ndustry was the production
f gold and silver threads.

The Early Warning of the Terns

Thousands of terns have replaced the Army on an island fortress originally designed to detect an enemy invasion of New York. The enemy has now arrived, and a major ornithological disaster may be upon us

by Helen Hays and Robert W. Risebrough

Great Gull Island is a small, unnhabited pile of rocks, clay, and hifting sands at the entrance of ong Island Sound between the astern tip of Long Island and Coniecticut. Because of its strategic loation, for half a century the island erved as part of the defense system f the nation; today, the striking inrease of birth-deformed birds there nay be a warning of a new and nore insidious danger.

The island is an excellent habitat or terns, small members of the gull amily that nest on isolated coasts nd barrier beaches throughout the vorld. To survive in these temestuous areas of winds, tides, and hifting sands, the terns have to be daptive and sensitive to change: lways shifting, colonizing newly ormed habitats, or quickly desertng old ones as they are destroyed y the elements or by man.

Nearly a century ago, when the apacious millinery trade in its puruit of feathers for fashion threatned the survival of terns on the ast Coast, conservationists proided a warden on Great Gull Isand to save the birds. The 14,000 erns on the island became the last esting colony, the last hope for erns in the New York region, as ther colonies on Long Island Sound were wiped out by plume unters and eggers.

Shortly after 1900, terns became a protected species when a pioneerng piece of conservation legislation vas passed in the United States. But, ironically, the legislation came too late for the terns on Great Gull Island, for in 1897, on the eve of the Spanish-American War, fearing attack by a Spanish armada, the United States government had begun the construction of Fort Michie on the island. With the arrival of the military, the terns disappeared.

In the following decades, the shadow of war rarely lifted from Great Gull Island. During World Wars I and II, the military used the island for its continental warning and defense system. From tall observation towers, soldiers scanned the ocean, always alert to the danger of attack. Over the years, the fort became a complex maze of gun emplacements, ammunition depots, barracks, and towers. By the end of World War II, the island was almost completely covered with concrete and asphalt. And the terns avoided this unnatural transformation of their former habitat.

Then, in the late 1940's, Fort Michie lost its function in the warning and defense system for the continent. It became a symbol of obsolete military equipment and strategy, and in 1949 the Army abandoned the island, leaving behind its concrete and asphalt, junkpiles, man-made hills, and a necklace of traprock boulders placed around the island to stabilize its shores. Although man was gone, the habitat was too disturbed for the terns to return.

Yet by the late 1940's, the terns of Long Island badly needed a new breeding area; the old protective legislation was no longer adequate to save them from new developments. The encroachment of factories and housing developments in coastal areas, along with the conversion of beaches to public parks, drastically reduced the number of undisturbed nesting areas for terns in the New York region.

Aware of the island's history, The American Museum of Natural History and the Linnaean Society of New York worked to acquire Great Gull Island, hoping that it might again become a large colony for nesting terns. In 1949, the Museum received title and assigned to the Linnaean Society the task of returning it to a condition suitable for terns.

In 1949 and 1950, several of the buildings were leveled, vegetation was burned, and sand was deposited in an effort to create artificial beaches. Each year the island was visited by ornithologists from the Linnaean Society and the Museum, but it was not until 1955, after everyone had given up hope that the birds would ever breed there again, that twenty-five pairs of common terns were found nesting. The birds had not utilized any of the areas prepared for them, but had laid their eggs on the traprock at the eastern edge of the island. The numbers of terns increased each succeeding year and today, once again, the island is the site of one of the largest colonies in Long Island Sound, comprising about 7,000 birds.

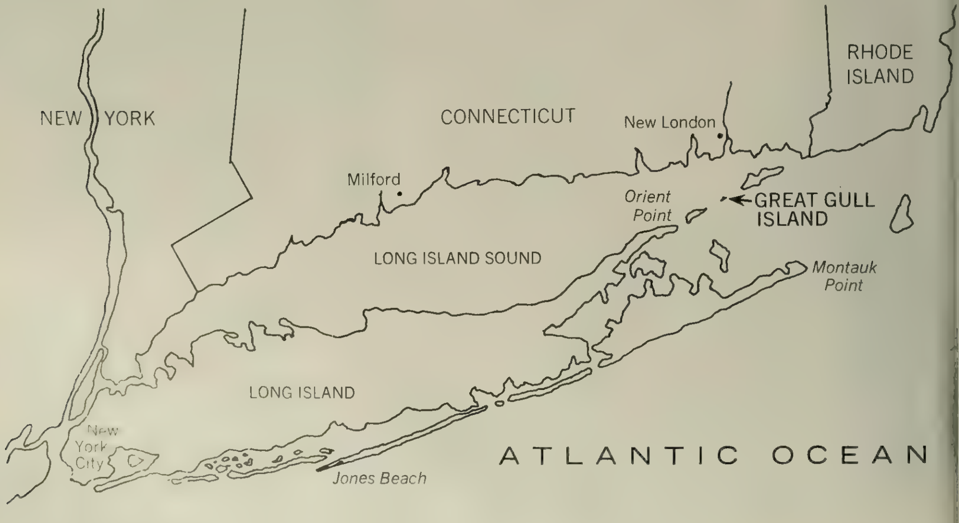
When people now land on the island in late spring or early summer, the terns swirl noisily from the ruins of the fort, challenging the intruders and diving at them should they approach the nest sites. Reminders of the island's occupation by the military still remain everywhere. The ruins of the abandoned fort, overgrown with vegetation, stretch from one end of the island to the other. The battlements are manned, however, by new defenders. On patches of exfoliating concrete in the gun emplacements and in the open areas that were once building foundations, common terns incubate their eggs and feed and brood their young. The roseate terns, less aggressive than the commons, deposit their eggs in the grassy edges of the open areas or under boulders on the outer beaches.

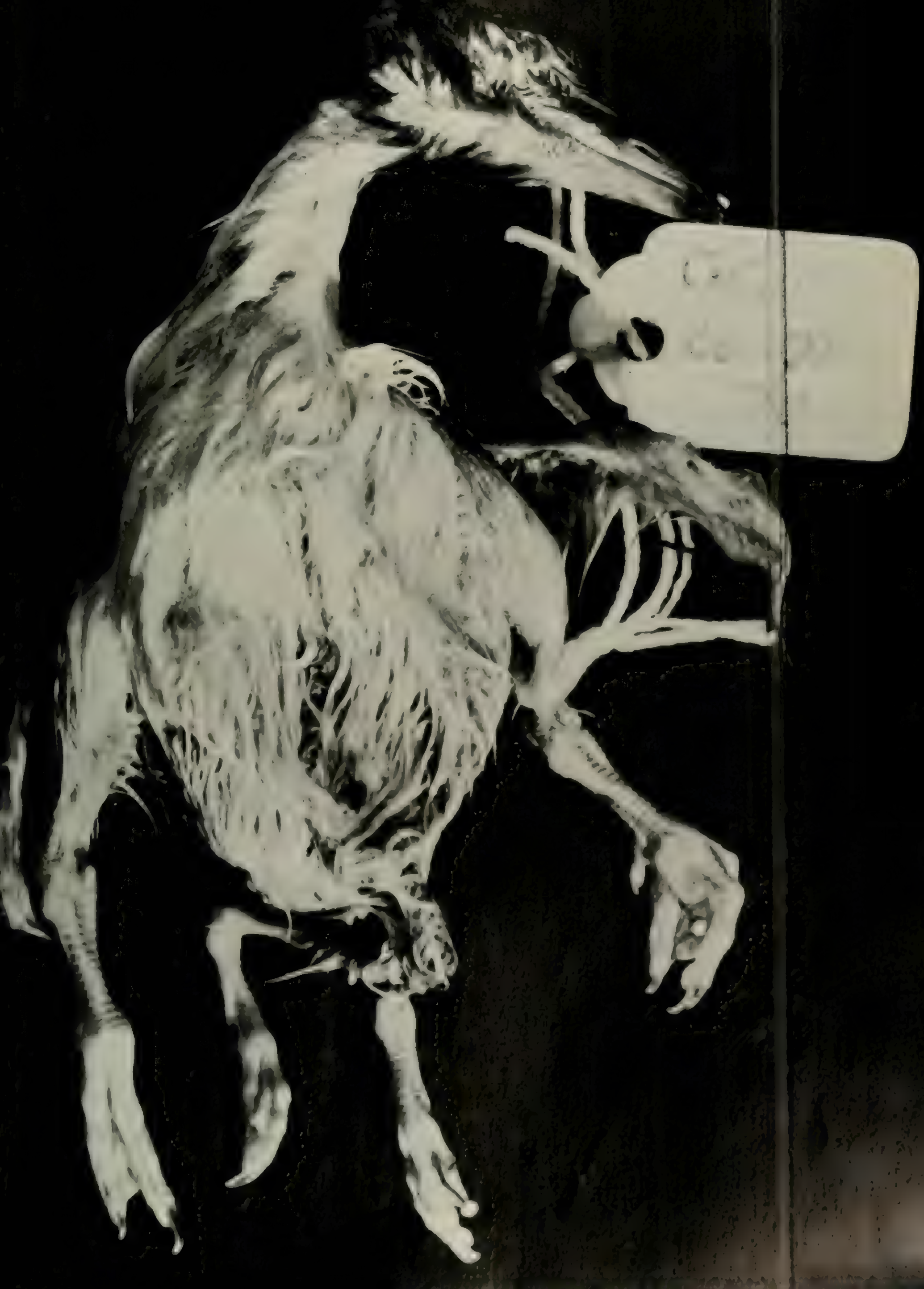
Their utilization of the ruins of the old fort on Great Gull Island demonstrates the tern's remarkable adaptability and use of habitat, a previously unknown characteristic of the species. A number of other species also occupy parts of the ruins. Barn swallows dart in and out of the weathered buildings, patching them with mud for their nests. Bayberry and wild rose, as well as several species of grasses, have invaded the ruins, making them habitable for nesting red-winged blackbirds, song sparrows, and spotted sandpipers. Starlings also nest in the eaves of buildings.

By 1966, the colony appeared sufficiently large and stable to permit ornithologists from the Museum to undertake studies of the breeding biology of both species of terns, as well as of several of the other species nesting on the island.

During the summers of 1967 and 1968, however, there was a great deal of rain and a scarcity of fish.

Chemical pollutants, such as PCB's, are highly suspect as the cause of an alarming increase in gross birth deformities among the terns on Great Gull Island This four-legged common tern chick died three days after hatching





Still straining to fly after fourteen weeks, the abnormal common tern, right, can only manage to rise a few feet. It had the double misfortune of being born without secondary flight feathers in a nest built within the insurmountable rim of a huge gun emplacement. It is doomed in this concrete enclosure. The fate of the five-week-old chick, far right, is similarly sealed: it was born without tail feathers, primary, and secondary flight feathers. Fort Michie's ruins, below, still dominate the landscape.

Many young terns died from exposure, starvation, or both. A major problem in the field of population biology is determining the productivity of a species under a variety of environmental conditions, favorable and unfavorable. The colony on Great Gull Island appeared to be an appropriate site to study this problem in relation to terns because the island's size, seventeen acres, was small enough to permit a daily checking of all nesting areas.

Daily coverage of the nesting grounds permitted large numbers of young terns to be marked at hatching, then followed with relative ease up to the time of fledging and departure from the colony. Studies of survival and mortality of both species of terns were begun in 1969. The number of field workers increased each weekend with the arrival of volunteers from the Museum. To avoid exposing the eggs and the young terns to the midday sun, all work in the colony was carried out whenever temperatures were favorable, usually in the early morning or late afternoon. The terns invariably put up a vigorous defense. Working in a tern colony is strictly a "hard hat" job, since the terns do not hesitate to strike unsuspecting heads with formidable force and very sharp beaks. Usually several workers would traverse an area together, looking for new nests and young birds.

At hatching in 1969, more than 2,000 young terns were examined and marked with temporary plastic bands. Of these, one young common tern was found with an abnormal bill and an upper mandible crossed over its lower. Then, two young roseate terns were found, which appeared normal, but which were missing flight feathers in both wings. We noted these deformities, but the flight feathers of the roseates appeared to be growing again. In a sample as large as 2,000 individuals, a few abnormalities are to be expected, and we did not attach special significance to these.

In 1970, however, when the study was repeated, we noted a sharp increase in the number of abnormalities. Four young roseate terns and thirty-three young common terns were found with visible defects. Some of these appeared normal at the time of hatching, but later, when they were between two and four weeks old, lost their primary and secondary flight feathers.

Feather loss is a new phenomenon that has not been previously described, although in the past many thousands of terns have been banded in Massachusetts, the Carib-

Crossed mandibles were discovered in the colony in 1969, the first full year of the research project. This roseate tern chick, from the 1970 breeding season, was collected when three weeks old for chemical analysis of its tissues.

ean. and on islands in the Pacific. Although these birds appeared to be healthy and vigorous, they could not fly. Two lived as long as six weeks. Many disappeared, however, so complete observations of their mortality rate were not possible. The feather loss did not seem to be necessarily permanent, as one of he young common terns found with no primary and secondary flight feathers was seen flying a month later at Milford, Connecticut, about 80 miles away.

Other abnormalities were comparable to those observed in human "thalidomide babies." One chick had underdeveloped legs and feet with almost no down, and another had four legs. Several showed abnormalities in the development of he bill. One chick had extremely small eyes.

It was at this time that the authors combined forces and experience in an attempt to determine he causes of the abnormalities. Our suspicions centered on environmental pollutants in Long Island Sound, he flush for much of the effluvia of New York and Connecticut. An investigation of this type, however, encompasses many different disciplines, and only detailed studies, over a period of time, will tell us what is actually happening to the population structure and reproductive capacity of the species affected by pollutants. In order to identify he pollutants that might be responsible for the abnormalities observed in the field, complex research in the chemistry laboratory is also necessary. The studies during the present year, therefore, were carried out with the realization that we were dealing with a new kind of enemy force, far different from the ravages of the plume hunters or the destruction of breeding sites. This enemy foreshadowed grave consequences for the future of the terns and quite possibly for man himself. There was no doubt that we were looking at the tip of a potentially disastrous iceberg.

This year's incidence of gross defects among newly hatched chicks was approximately comparable to that in 1970. The first to be found had an abnormal foot and leg. The second had a rudimentary upper mandible, which had grown out from above its eyes. The third appeared as if injected with air or water; its skin was swollen about the head, neck, and abdomen. The fourth had no left eye and a slightly crossed bill. Three others had bald spots on their bodies where feathers had not developed. The loss of flight feathers was again observed in many of the chicks. These are the kinds of effects that might be expected from a chemical capable of affecting gene reproduction during embryonic cell division.

Added to this, in 1971 a new abnormality was observed in the colony for the first time: thin-shelled eggs not sufficiently strong to support the weight of the incubating parent. This phenomenon is now familiar to pollution biologists, having been first reported in British peregrine falcons in the 1950s. The brown pelicans in California have not bred successfully for a number of years because of this problem, and some of the birds of prey in this country are suffering serious population declines for the same reason.

Researchers in this area believe that shell-thinning is caused primarily by the DDT compound DDE. This pollutant, a derivative of the insecticide, is only slightly poisonous to most individual organisms, but it may produce such effects as shell-thinning, which lowers the reproductive capacity of the species. DDE has been shown to produce shell-thinning under experimental conditions in mallard ducks, American kestrels, quails and doves. Wild species that are suffering from the thin eggshell syndrome have also been found to be contaminated with DDE.

The DDT levels we measured in the abnormal young terns on Great Gull Island and in the fish brought to the colony by the adults in 1970, however, were no higher than in many other bird populations. In fact, they were lower than some. While we have no basis for believing that any of the DDT compounds are responsible for the observed deformities in the young terns, we cannot rule it out as a possible cause of shell-thinning. This was not observed until 1971, and we have not yet measured DDT levels in the 1971 specimens.

Levels of other heavy metals, such as lead and cadmium, are currently being measured, but until much more data from other populations are accumulated, we shall not know what the expected natural levels of these elements in tern eggs should be, or how to interpret the concentrations found.

What we did find were relatively high levels of polychlorinated biphenyls, PCB's, in the tern tissues and in the fish upon which the birds feed. These compounds have a number of chemical properties similiar to DDT. Like DDT and its derivatives, they become concentrated in the fatty tissues of animals when present in a food chain, but they are even more stable. Used extensively as heat-exchange and insulating fluids in high-voltage electrical equipment, PCB's are also added to paints, plastics, and rubber to make these materials more resistant to breakdown. This property of resistance to most kinds of biological and chemical degradation which has made them so a ful to industry, are what make PCB's such persistent pollutants when released in the environment. Interestingly, in some of the studies in which PCB's were fed to birds in order to determine toxic effects, the birds lost feathers. The PCB's may well, therefore, be responsible for the feather loss observed in the young terns on Great Gull Island.

Recent research conducted in the Netherlands has demonstrated that PCB preparations often contain small concentrations of compounds that are chemically similiar to the extremely toxic dioxins. These are the chlorinated dibenzofurans, and the relationship is significant because these dioxins have produced a high incidence of birth defects in recent experiments. Small amounts of the chemicals were injected into fertile chicken eggs, producing grossly deformed chicks of the same type we have observed in the young terns. Obviously, much further research is necessary before we can definitely pinpoint just what pollutants are responsible for what deformities, and what the cause-and-effect relationships are.

It is important to point out that although all the evidence is not yet in and weighed, what is happening to the terns on Great Gull Island is of critical significance—not only to the local survival of the species, but quite possibly to humans as well.

We might hypothesize that the effects of environmental pollutants, such as those mentioned, would be detected first in the tern colony. Long Island Sound is one of the more polluted areas of the world's oceans, a distinction it shares with the Baltic, the Mediterranean, and the southern California coastal waters. And the effects of chemical pollutants could be expected to appear first in a species that is relatively high on the food chain, especially one that preys upon fish.

Not all the pregnant women who ingested thalidomide gave birth to defective children. Rather, the incidence of defects was significantly increased. We could assume that environmental chemicals producing comparable effects would behave similarly and that their presence would not mean that all individuals would be equally affected. A normal-looking individual might have a higher concentration of certain pollutants than one with four legs. Consequently, many thousands of young must be examined to detect the first effects of pollutants building up in a population of any species. It is probable that as the levels of harmful pollutants increase in a population, more individuals will show adverse effects. But only continued work will verify this.

In addition, high priority should be given to a detailed study of the pollutants now present in the waters of Long Island Sound. All of these, we must emphasize, are waste products. Normally, the waste products within an ecosystem are recycled, used again and again. Thus the tissues of a dead bird gradually are converted into elementary material. Carbon dioxide re-enters the atmosphere to participate once again in photosynthesis. Phosphates re-enter the water to be incorporated once again into phytoplankton, from which they pass into zooplankton, then up the food chain through fish to terns, and so on.

Technological man has made two fundamental changes in this natural process. By mining vast amounts of certain heavy metals and salts, such as phosphates, the mobilization has been greatly increased. When these become waste products in excessive amounts, the threshold of harm to certain species is passed. Also some of the new synthetic chemicals are relatively resistant to breakdown, and so more readily build up to concentrations harmful to a great many more species.

If our priorities are rearranged to meet the mounting environmental and biological crises caused by the exploitation of natural systems, sufficient warning will be needed to provide time to change our technological direction and commitment of natural resources. We have had such warnings about air pollution, sewage in our waterways and lead poisoning, for example, and some measures are being taken to correct these threats to human health and well-being. Now the terns on Great Gull Island are issuing a warning through their pitiful deformities and threatened survival. That seventeen-acre island that is home to the colony occupies a strategic position analogous to when it served as a military outpost. The terns occupying the approaches to New York City are now inadvertently detecting a newer, more insidious enemy to man: contaminants. Presently disturbing the reproduction of the terns, these contaminants may, someday soon, result in an increase in the numbers of human birth defects as they work up through the food chain to the ultimate consumer. Fort Michie, now in ruins, may yet provide us with an early warning against encroaching danger.

Boulders dumped by the Army to prevent erosion cover the island's shoreline. It was thought that this ruination of habitat would prevent the terns from reclaiming their lost colony, but they have adapted and now nest in the network of rocks.

As we go to press, verified reports of significant feather loss among chicks in tern colonies in Massachusetts; Jones Beach, New York; and the Dry Tortugas, off Florida, have been received. The scope of the disaster is broadening.

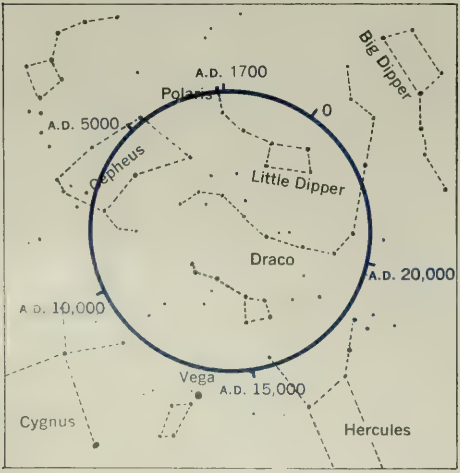
Sky Reporter

Always a New Sky Show When Julius Caesar needed a simile for standing firm, he quite naturally looked to the sky:

> But I am constant as the northern star,
> Of Whose true-fix'd and resting quality
> There is no fellow in the firmament.

Noble Caesar had the right idea, but the stars are not quite so constant as Shakespeare had him believe. The stars do not appear to change much in one man's lifetime, but in a longer view, the dome of heaven is an ever changing show.

Unlike Caesar, we know that the universe is a violent place where stars are born and die, sometimes in catastrophic explosions; where whole galaxies are flying apart, sometimes colliding in the rush; where matter exists in unimaginable forms in neutron stars and black holes. All this new knowledge is in our heads; to our eyes, the night sky looks much the same as it did in Caesar's time. But not quite.



The position of the north celestial pole swings through this circle in the sky every 26,000 years.

The North Star he admired so much is moving across our sky—not so much because it is moving but because we are moving. The North Star, Polaris, which is, in fact, much closer to the north celestial pole than it was in Caesar's time, will be closer still in 2105. In another 10,000 years, Polaris will be nowhere near the north celestial pole.

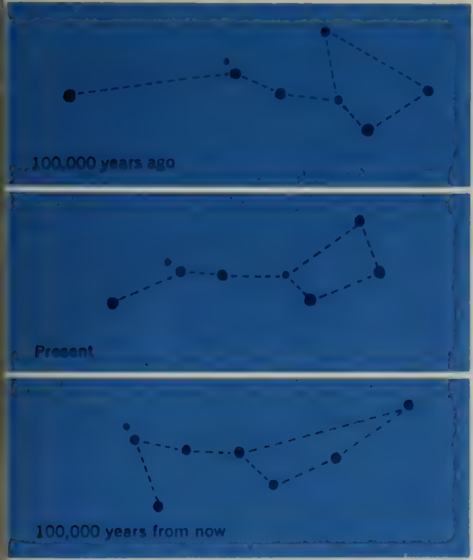
Other things are going on, so slowly that man does not notice. The stars are moving in relation to one another. The groups of stars by which we recognize constellations will have different shapes in the distant future; the Big Dipper, for example, will be squashed beyond recognition in a mere 100,000 years. The moon will move farther away, far enough so that total eclipses of the sun will no longer occur. The earth will slow its rotation; someday we will have the 25-hour day busy people so devoutly wish for. The unkindest cut of all, at least for poster artists and those who make wizard's robes, could be the loss of Saturn's rings to micrometeoroid bombardment.

As the centuries tick off, we may gain more than we lose. In just a hundred million years, our galaxy will have rotated enough so that we will be able to see Maffei I, a nearby island universe that we cannot see now because, from where we sit, it is behind the dust and gas clouds of our own galaxy. Best of all will be the appearance of new objects and phenomena we have no way of expecting. Just as each new astronomical technique has revealed whole classes of celestial bodies undreamed of, so the passage of time seems sure to bring with it new additions to our sky. After all, the time that man has been systematically observing the sky is only a blink on the time scale of the universe.

When Caesar spoke of the constancy of the North Star, he was assuming that the earth on which he stood was also constant. In addition to rotating on its axis and revolving around the sun, however, the earth is precessing like a top. When a spinning top is tilted from the vertical, the downward force of gravity causes its axis to swing slowly in a circle. The earth is tilted from the vertical (in relation to the plane of its orbit around the sun), and the pull of the sun's and the moon's gravity on the earth's equatorial bulge causes its axis to swing slowly in a circle. One complete rotation through the circle takes 26,000 years.

Right now, earth's North Pole aims at a point in the sky (the north celestial pole) not quite a degree from Polaris, and we call Polaris the North Star. But after 2105 the north celestial pole will swing away from Polaris; in another 11,000 years or so, after swinging through Hercules, it will be near Vega and will then swing back between the Big and Little Dippers, reaching Polaris to start another 26,000-year cycle.

Polaris appears to move in relation to the north celestial pole because of the earth's motion. But the stars themselves really are moving, many of them in groups. The Big Dipper was not a dipper 100,000 years ago, and will not be in another 100,000 years. As the diagram indicates, the two outermost stars are moving away from the dipper configuration. All the others are moving, too, but they are part of a group moving together, and so are not changing relative to each other.



The stars in the Big Dipper are moving through space but not all together. The constellation did not look like a dipper in the past and will not in the future.

In our solar system, total solar eclipses in which a moon just covers the sun and thus reveals the solar corona are unique to the earth. At least thirty-one other moons circle other planets in the system, but in no other case is a moon just the right size and distance from its planet to just cover the disk of the sun.

Our moon is slowly drawing away from the earth, and will someday be too small to completely cover the sun's disk. Even now, when an eclipse occurs at a time when the moon is not close to the earth in its monthly circuit, an annular eclipse occurs in which the disk of the moon does not completely cover the disk of the sun. In the future all eclipses will be annular.

At one time the earth rotated much faster, and the moon was much closer. Some calculations put the moon as close as a few of its own radii, and the day at four hours. Now the earth is slowing down at the rate of about 1/1,000 of a second every century. If this keeps up, the day will be 25 of our present hours long in just 360 million years. (We could keep our 24-hour system by using longer hours.) If you really want to look ahead, George Darwin calculated that eventually the earth would always keep the same side toward the moon, as the moon now does to the earth. At that point the month and the day would both equal 47 of our present days. The 47-day day is a little further off, though: something like 50 trillion years.

On the time scale of the universe, Saturn's rings may turn out to be as ephemeral as a rainbow. The rings are made of very small particles, each is subject to collisions with interplanetary dust particles. One recent calculation indicated that the rings may be losing an inch of thickness every hundred thousand years or so. The rings are only a mile or two thick, so unless they are also gaining new material, they can endure this erosion for only so long. This dour prediction has a brighter converse, however. If the rings have a short lifetime, perhaps they are of relatively recent origin. In other words, perhaps the rings formed long after Saturn did. If it happened to Saturn, perhaps it will happen elsewhere. A future Sky Reporter column might be devoted to new studies of the rings of Jupiter. Keep reading.

JOHN P. WILEY, JR.

Celestial Events

November's moon, new on the 17th, is in the evening sky thereafter, and reaches first-quarter on the 25th. The moon becomes full on December 2 and is at last-quarter on the 9th.

Venus, by late November, has become a prominent evening star, appearing in the southwest at dusk and setting about an hour and a half later. In December it continues to brighten and to set later and later. Jupiter is an evening star, but too low in the southwest to be seen after sundown. It becomes a morning star after conjunction in mid-December. Saturn, after opposition in late November, rises shortly before sunset and sets during morning twilight. Mars, now in Pisces, continues to grow dimmer, but may still be easily found high in the south early at night, setting close to midnight. Mercury reaches greatest elongation in the evening sky in late November, but it is too low at sunset to be found easily.

November 17: The Leonid meteor shower reaches maximum. With the moon just past new, after-midnight skies will be dark. Although normally a weak shower, producing an average fifteen meteors per hour for the single observer, the meteors are often swift and bright.

November 19: The crescent moon is in conjunction with both Jupiter and Venus today. If the two-day-old moon is visible in exceptionally clear western skies, you may see Venus above and to the right of the moon, Jupiter farther to the right and lower than Venus.

November 23: Mercury is at greatest elongation (east of the sun) in the evening sky. This is not a favorable elongation, however. The planet is only about ten degrees high at sunset.

November 25: Saturn is at opposition. Now located directly opposite the sun in earth's sky, the planet rises at sunset, appears highest at about midnight, and sets at sunrise.

November 25-26: The bright object above the moon on these evenings is Mars. On the 25th, Mars is above and to the left of the moon, but after conjunction early the following morning, Mars is above and to the right of the moon on the evening of the 26th.

December 1: Saturn may be located this evening by looking below and to the right of the rising moon, which is almost full. The moon separates slowly to the left during the night.

December 2: Mercury is stationary in right ascension and begins to move retrograde (westerly) between sun and earth.

December 8: The earliest sunset in the midlatitudes of the Northern Hemisphere occurs today.

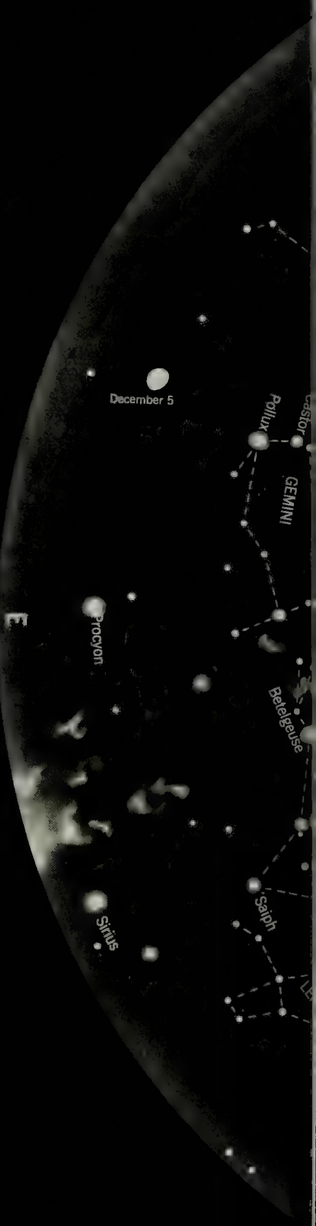
December 9: Jupiter is in conjunction with the sun and passes from the evening into the morning sky.

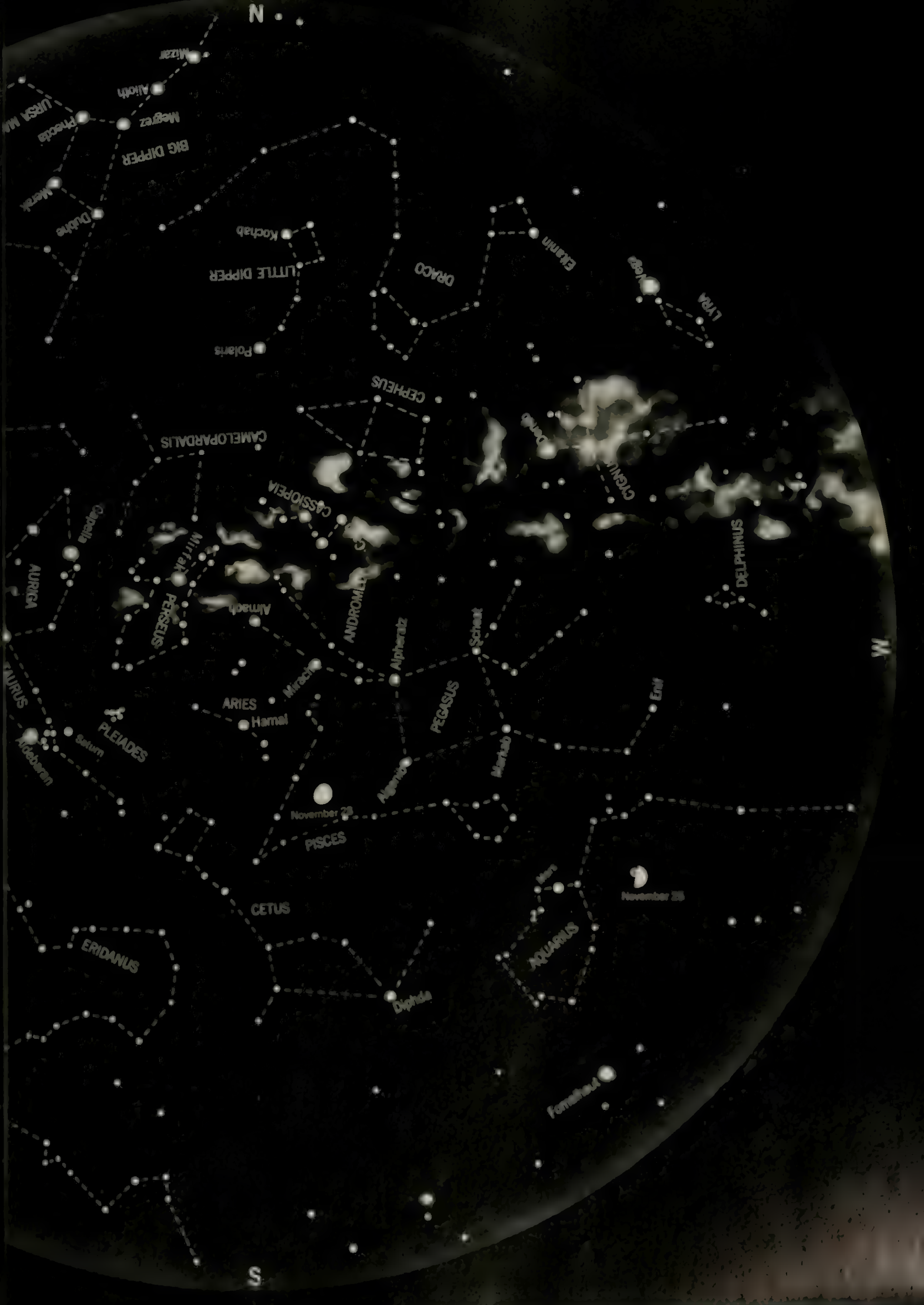
December 12: Mercury is at inferior conjunction, located between earth and sun, and enters the morning sky as it moves west of the sun.

December 14: The Geminid meteor shower reaches maximum. Observers may expect to see up to fifty meteors per hour, with no moonlight problems for after-midnight hours. About half the maximum rate may be seen a day before and after.

THOMAS D. NICHOLSON

★ Hold the Star Map so the compass direction you face is at the bottom; then match the stars in the lower half of the map with those in the sky near the horizon. The map is for 10:20 P.M. on November 15; 9:20 P.M. on November 30; and 8:20 P.M. on December 15; but it can be used for about an hour before and after those times.

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THE SEA SNAKES ARE COMING

A sea-level canal across Central America could introduce a new breed of predator (and prey) into the Atlantic

by
William A. Dunson

A banded sea snake swims across a reef in New Caledonia, right. Most sea snakes are confined to one part of the world, but some can cross oceans.

"As we sailed along we saw multitudes of grampuses every day; also water-snakes of divers colours. Both the Spaniards and Indians are very fearful of these snakes, believing there is no cure for their bitings." Basil Ringrose, 1679, in *The Buccaneers of America*, by John Esquemeling.

The accuracy of this early description by an English pirate of the yellow-bellied sea snake, *Pelamis platurus*, off the coast of Ecuador could not be greatly improved upon today. This venomous member of the sea snake family is found in great numbers along the Pacific coasts of Mexico and Central and South America, between Baja California and Ecuador. The extreme variation in coloration ("divers colours") of the serpent is most unusual, and we have no more access to an antivenin for its poison than Ringrose had in 1679.

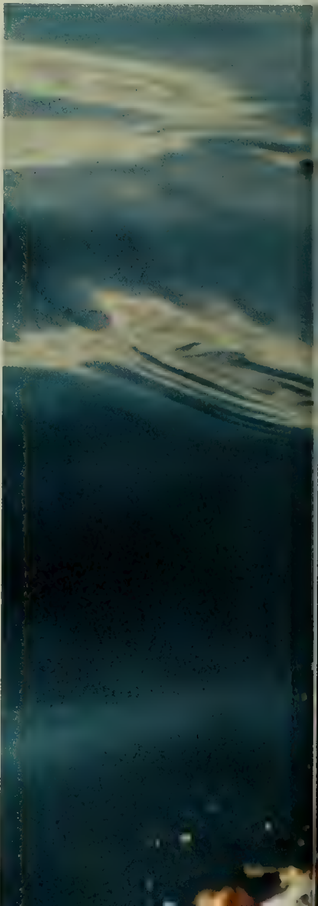
Our appalling ignorance of this remarkable snake's habits has recently been forcibly brought home by a renewal of interest in construction of a sea-level canal between the Atlantic and Pacific Oceans. The Atlantic-Pacific Interoceanic Canal Study Commission, which for economic and military reasons recommended construction of a sea-level canal in Panama, gave little consideration to the possibly deleterious effect of intermingling organisms from the two oceans. Other scientists, however, reflecting our increased ecological knowledge, have shown more awareness of the problems. A National Academy of Sciences committee reported that "great danger would result from building a sea-level canal. . . ." The Pacific yellow-bellied sea snake came to center stage in this debate because it is one of the species that no one would like to see ushered into the Atlantic Ocean by our engineering follies. Another undesirable Pacific immigrant could be the crown-of-thorns starfish, which consumes coral.

To estimate the likelihood of the yellow-bellied sea snake passing through a sea-level canal, we must understand the habits of this marine reptile. It has traditionally been considered a pelagic "blue-water" species that only rarely came close to land. But in a recent cruise of the Scripps Institution of Oceanography research vessel *Alpha Helix* between San Diego and Panama, we often observed this sea snake present within a few miles of shore, and we caught some individuals within a few hundred feet of land. Another striking finding of our recent studies is that the yellow-bellied sea snake drifts passively with surface ocean currents and is sometimes swept onto coastal beaches, where it dies in the sun.

Sea snakes represent the end result of millions of years of specialization for life under very stringent conditions. For a reptile, the ocean is anything but an environmental featherbed. Its high concentration of salts (about 3.5 percent sodium chloride) makes it difficult for reptiles to retain water in their bodies, yet keep the salt concentration low.

A lookout on the *Alpha Helix* searches for drift lines, the flotsam-littered slicks formed when surface currents converge. The passively drifting yellow-bellied sea snake is often present in such drift lines.

A brightly striped sea snake, right, moves along the bottom in the Ryukyu Islands. At lower right, a yellow-bellied sea snake floats with the debris in a drift line off the coast of Mexico.



The total salt concentration of the body fluids of vertebrates is usually only about one-third that of sea water. Marine mammals keep a low blood-salt level by excreting concentrated urine, but the reptilian kidney is very weak and completely unable to produce urine more concentrated than blood. It is not surprising, therefore, to find that all marine reptiles have salt-excreting glands.

The kinds of salt glands developed reveal the divergent evolutionary paths taken by the ancestors of marine reptiles. In turtles, salty "tears" are secreted by a gland behind the eye. In the marine iguana, a large gland in the nose secretes a fluid that is sneezed out the nostrils. In the sea snakes, I have recently discovered a third type of gland, which is located under the tongue, that secretes salt into the mouth.

Sea snakes are closely related to cobras and kraits, and like them, have fixed fangs and a potent venom. As a family, they are widely distributed, being found between the latitudes of South Africa and Japan in the western Pacific and Indian Oceans, eastward to a zone between Mexico and Ecuador.

There are no sea snakes in the Atlantic Ocean, the Mediterranean Sea, or the Red Sea. The Atlantic only narrowly escaped being a home for these successful reptiles, which apparently migrated to the New World sometime after the Central American land bridge rose out of the sea for the last time, about four million years ago. Occasionally, sea snakes are found just inside the South Atlantic at Cape Town, but these individuals are as

The diversity of color and pattern among yellow-bellied sea snakes shows clearly in this group of specimens inside a laboratory aquarium.

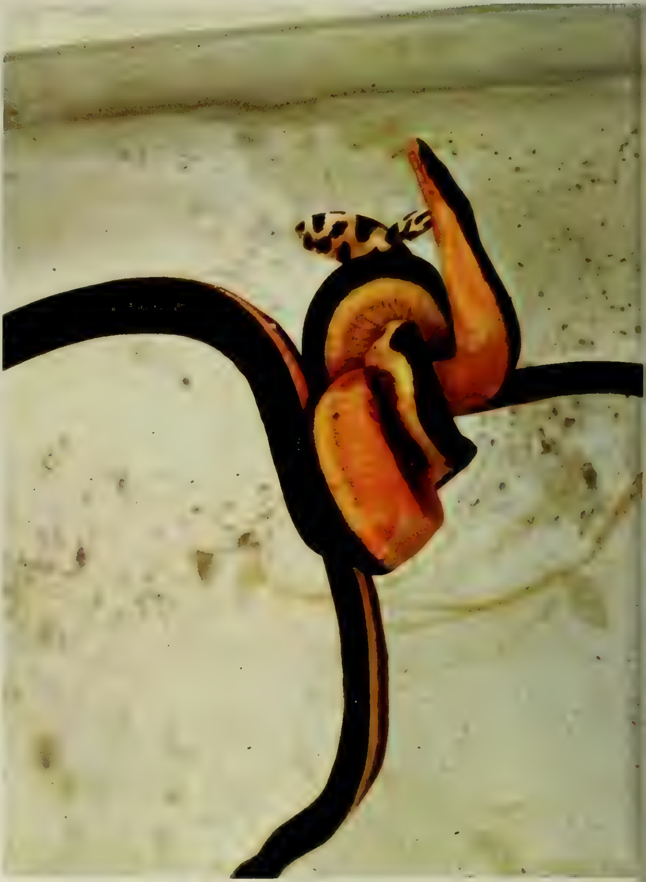
Two sea snakes are knotted together in what may be a unique photograph of mating activity. Young are born alive at sea.

rare and out of place as the doomed sea turtles swept to the British Isles by the Gulf Stream.

Thus, sea snakes are only rarely found outside the tropical zone or the transition zone between the tropics and the temperate zone. I believe that even the most widespread form, the yellow-bellied sea snake, can breed only if the water temperature is above 68° F. Because it is able to feed at the surface and to float with ocean currents, this particular snake has by far the greatest range of any sea snake. Other kinds, such as *Laticauda*, the banded sea snakes, are much more restricted in range.

The greatest number of all sea snake species is found in the Indo-Australian area, the snakes' ancestral home. The Strait of Malacca, between the Malay Peninsula and Sumatra, harbors as many as 27 different kinds. Unfortunately, we still know very little about how so many species are able to live in the same area without competing with one another.

The bits of information we do have about the life history and ecology of sea snakes reveal many interesting adaptations. Being air breathers, these snakes must surface. The flattened tail and laterally compressed body make them efficient divers, although most remain in relatively shallow water. Because many species feed on eels and other bottom-dwelling fish, they cannot



venture into water too deep for their feeding dives. George Pickwell, an expert on sea snakes, has observed *Laticauda* trap small fish in rock crevices with the folds of its body and then grasp the fish with its mouth. I have watched a sea snake in a small aquarium use coils of its body to immobilize a fish against the side of the tank before seizing and swallowing it. This feeding response may explain how sea snakes can catch fish that could easily outswim them in open water. Shrimp and prawns have been found in the stomachs of certain sea snakes; they may have been caught while they were buried in bottom sand or mud.

The yellow-bellied sea snake, however, is entirely a surface feeder. This snake floats at the surface, perhaps simulating a stick, and fish are attracted to it as to any floating object. The snakes have been observed many times with a group of small fish faithfully swimming underneath; with a swift sideways strike the snake has a meal.

Respiration in sea snakes is interesting because they are reportedly capable of staying submerged for anywhere from two to eight hours. Their metabolism is much lower than that of mammals like ourselves, but this only partially explains dives of this duration. The sea snake's lung is greatly enlarged, extending all the way to the base of the tail. As in other snakes, the left lung is small, while the right lung is highly developed. Even the trachea, the windpipe connecting with the lung, has been modified to provide an area for exchange of gases. Certain areas of the lung in the rear of the body may serve no respiratory function but may instead act as a hydrostatic organ. In this way the snake might be able to regulate its buoyancy. Sea snakes may also have an increased tolerance for anoxia, or lack of oxygen, allowing them to pay off an "oxygen debt" after they return to the surface.

However these snakes tolerate submersion, they certainly feel at home in the water. Some sea snakes in the Philippines, which feed only on bottom-dwelling eels, have been observed diving down out of sight in clear water of a maximum depth of 500 feet. We do not know how they avoid the effects of great pressure at these depths. Types of sea snakes that must dive to the bottom for their food are confined mainly to waters within the 100-fathom line. Thus they may not be capable of diving to depths greater than 600 feet.

Sea snakes differ greatly in their breeding habits. At breeding time, certain kinds, such as *Laticauda*, mass near islands in the tropical Pacific. In the Philippine Islands there is a commercial fishery based on the islets where the snakes congregate. In a single year on Gato Islet, as many as 100,000 snakes are killed for their skins. Others are taken alive, spitted on pointed bamboo sticks, and then roasted or smoked before being eaten. Shore-breeding sea snakes lay their eggs in crevices or in caves and leave them to hatch, but the yellow-bellied sea snake never comes ashore, even at breeding time. Mating takes place at sea and the young are born alive in the water.

Several attempts have been made to define the breeding season of sea snakes, but it is by no means certain that reproduction is limited to a particular time of year. In areas with a pronounced rainy, or monsoon, season, it is quite likely that reproduction is timed to occur when the snakes return in numbers to the coast at the beginning of the storms.

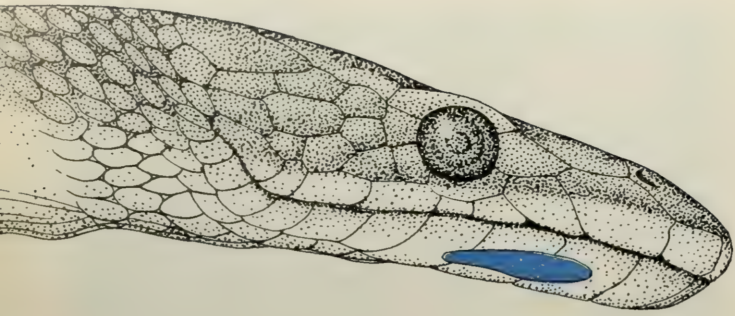
It is then that fishermen pulling in their nets encounter them along the coasts and estuaries of Southeast Asia. The snakes may move into river mouths where the salinity is quite low and on occasion continue up the rivers. In one case a sea snake was caught in a freshwater lake (Grand Lac) in Cambodia after having ascended the Mekong River.

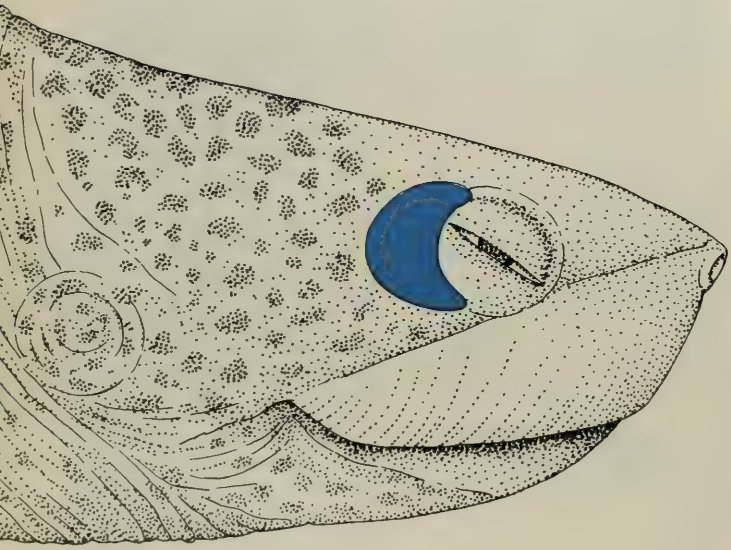
Temperature is a major factor in the distribution of sea snakes, and they are found primarily in the tropical areas of the world. In fact, the yellow-bellied sea snake is rarely found where the average temperature of the sea surface drops below 68° F. for even one month. This applies even to such equatorial regions as the Galapagos Islands or the Peruvian coast where the sea is relatively cool because of the influence of the cold Peru current coming up from the South Pole. Off the warmer Ecuadorian coast about four hundred miles away, sea snakes are numerous.

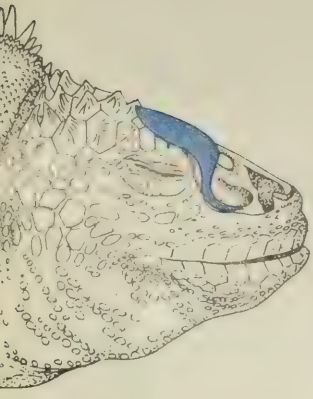
Cold surface waters keep the yellow-bellied sea snake out of the Atlantic Ocean. Migrants from the warm waters of the Indian Ocean are sometimes carried as far as Cape Town on the southwestern tip of Africa, but they soon die if they drift any farther. Cool waters would also prevent the yellow-bellied sea snake from invading the Mediterranean Sea, even if it could cross the barrier posed by the warm, salty waters of the Red Sea.

This snake tolerates heat no better than it does cold. I first suspected that the yellow-bellied sea snake was sensitive to high temperatures when I put some in a small bucket in the open sun at Acapulco and they quickly died. In the laboratory we found that the upper lethal limit was indeed low, about 91° F. Since the surface temperature of the tropical seas where these snakes live is as high as 88° F., I began to wonder how these snakes could live at the surface in the hot sun. The answer appears to be that the snakes dive into the cooler water below. Off the coast of Panama, we found that some snakes were cooler than the surface water that surrounded them. If the purpose of diving is only to escape the hot rays of the sun, then shallow dives would be effective because even an inch of water would partially protect the snakes.

This hypothesis, regulation of temperature by diving, is supported by the observations of a Mexican fisherman I met. He was familiar with yellow-bellied sea snakes and confidently predicted that the best time to find them was during rains. We did find snakes on sunny days, but on calm, cloudy days with intermittent showers, they were very numerous about five miles off the Mexican coast at Acapulco. According to my hypothesis, the snakes would not have to dive on rainy days when solar radiation is less intense, therefore more of them should be visible at the surface.





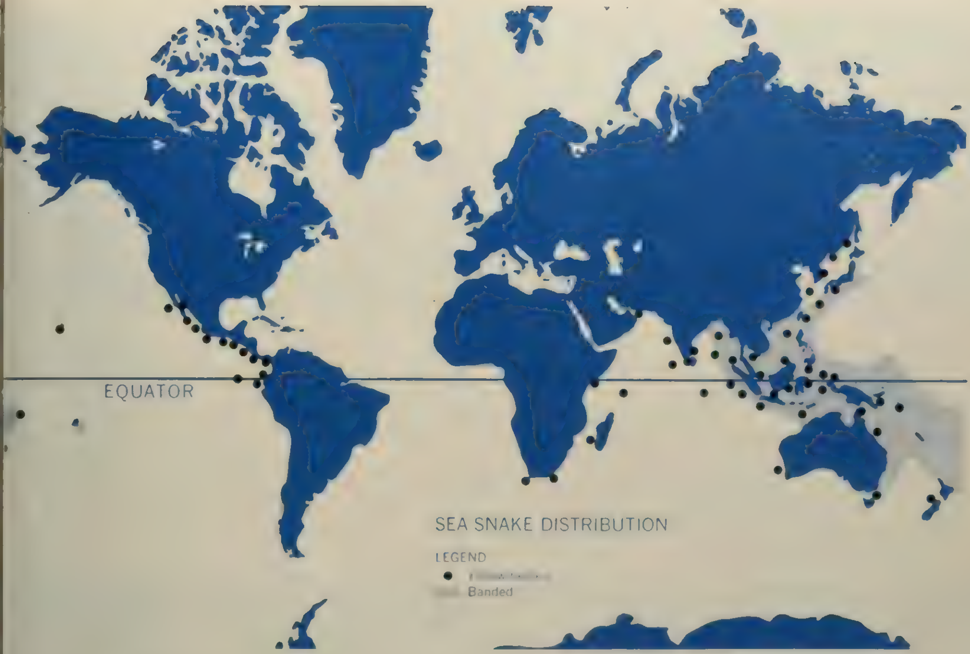


Marine reptiles have diverged in their evolution of salt glands. In the sea snake, top, the gland is under the tongue and empties into the mouth. In turtles, salty "tears" are secreted by a gland behind the eye. And in the marine iguana, bottom, a gland in the nose secretes through the nostrils.

The sun is not the sea snake's only enemy on the surface of the sea. There are potential predators both above and below. When not floating among the tree trunks and assorted debris of the land, the yellow-bellied sea snake is very conspicuous. The startlingly marked tail is especially noticeable, so much so that you might think that the snake wants to be seen. Some experiments carried out by Ira Rubinoff of the Smithsonian Marine Laboratory in Panama indicate that this may, in fact, be so. In the eastern Pacific the sea snake has no known enemies. Even such voracious Pacific predatory fish as snappers will refuse to nibble at the snake unless it is completely camouflaged inside a piece of squid, and then they reject the morsel as soon as they taste it. The reason for their aversion becomes obvious when the snakes are offered to Atlantic predatory fish, which have never encountered a sea snake before. These fish will eat the snakes, but in about one out of twelve meals they will be bitten by the snake and die. Thus it seems that there has been a selection pressure against those Pacific fish with a taste for sea snakes. They do not live long enough to reproduce themselves. Since both sight and taste appear to be involved in the recognition of the snake by Pacific fish, the coloration might be considered a warning to all concerned: "Don't tread on me or attempt to eat me."

However, even the most deadly animals usually have an Achilles' heel, enabling at least one predator to feed on them. In this case we suspect that some of the most famous snake eaters, the birds, feed occasionally on sea snakes. There have been isolated reports of eagles and seabirds eating sea snakes. Sea snakes have also been taken from the stomachs of Philippine moray eels.

As Rubinoff has pointed out, studies of predation on sea snakes are relevant to the possible movement of the yellow-bellied sea snake into the Atlantic Ocean through the proposed sea-level canal. If the snakes were to work their way into the Atlantic through the canal, as



eems likely. Atlantic fish would
nitially prey heavily on them be-
ore the strong selective force
gainst snake eating took effect. But
hen a sea snake population ex-
losion could occur, assuming that
ther environmental factors were
avorable.

The question of the ability of sea
nakes to move or to migrate is an
nteresting one since the various
pecies differ greatly among them-
elves in this trait. One of the most
stounding observations ever made
n massed sea snakes was reported
rom the Strait of Malacca by W.P.
owe in *The Trail That Is Always New*, 1932.

> Leaving Colombo we departed for Penang, and the voyage from now on became more interesting, as there was a good deal to be seen, such as rocks covered with sea-birds, chiefly Gannets and Shearwaters. To starboard lay the beautiful green island of Sumatra, and to the port the Malay Peninsula. The water now became very calm and oily in appearance. After luncheon on 4th May I came on deck and was talking to some passengers when, looking landward, I saw a long line running parallel with our course. None of us could imagine what it could be. It must have been four or five miles off. We smoked and chatted, had a siesta, and went down to tea. On returning to the deck we still saw the curious line along which we had been steaming for four hours, but now it lay across our course, and we were still very curious as to what it was. As we drew nearer we were amazed to find that it was composed of a solid mass of sea-snakes, twisted thickly together. They were orange-red and black, a very poisonous and rare variety known as *Astrotia stokesii*. Some were paler in colour and as thick as one's wrist, but the most conspicuous were as thick as a man's leg above the knee. Along this line there must have been millions, when I say millions I consider it no exaggeration, for the line was quite ten feet wide and we followed its course for some sixty miles. I can only presume it was either a migration or the breeding season. I have on various occasions looked in vain in these same waters, and also enquired from officers of ships navigating this region, but have failed to hear of a similar occurrence. Many people have seen snakes of this description but never in such massed formation. It certainly was a wonderful sight. As the ship cut the line in two, we still watched the extending file of foam and snakes until it was eventually lost to sight.

Our present knowledge of sea-surface phenomena can partly explain this unusual sight. Lowe emphasizes the sea's calmness and that the snakes were mixed with foam. This is a classic description of a slick, albeit an unusually long one. Slicks form when surface water currents converge. Anything floating at the surface, a few molecules of organic material, a sea snake, or a tree trunk, may be concentrated into slicks by the horizontal convergence of flow. I am convinced that the aggregation of sea snakes described by Lowe must have occurred in a large slick because I have observed the same phenomenon, only on a smaller scale, in the eastern Pacific.

On days with little wind, slicks also form off the coasts of Mexico and Central America and they often contain thousands of snakes. The association of yellow-bellied sea snakes with slicks has been noted many times by fishermen, but only rarely by scientists. It tells us that this sea snake probably spends most of its time at the surface in a passive, motionless state. Yellow-bellied sea snakes are rarely seen swimming actively unless disturbed or diving. They are commonly observed in association with drifting debris in slicks. On windy or choppy days these snakes are widely dispersed and difficult to find. On occasion, currents also carry the yellow-bellied sea snake onto beaches, where it perishes because it is unable to crawl back to the water.

The ability of the yellow-bellied sea snake to drift contributes to its success as a world traveler. Wafted by currents and feeding occasionally on fish that seek cover in its shadow, it can cross vast expanses of open ocean. But it does not habitually live in pelagic, or open ocean, areas, probably because these areas are relatively sterile. Fish are more abundant in the coastal zones. The open ocean is no barrier to its movements, however, as it is to many bottom-feeding species of sea snakes found in the Indo-Australian region.

All of the sea snakes are poisonous. In the early stages of their evolution for a life in the sea, sea snakes probably derived a considerable advantage from their venom. The original purpose of the venom may have been to subdue large prey and perhaps secondarily to protect against predators. Yet some sea snakes, for example *Laticauda*, are famous for their docile nature. Children in Fiji pick them up and are rarely bitten. On the other hand, certain sea snakes are easily aggravated and may bite readily if provoked by being stepped on or handled roughly.

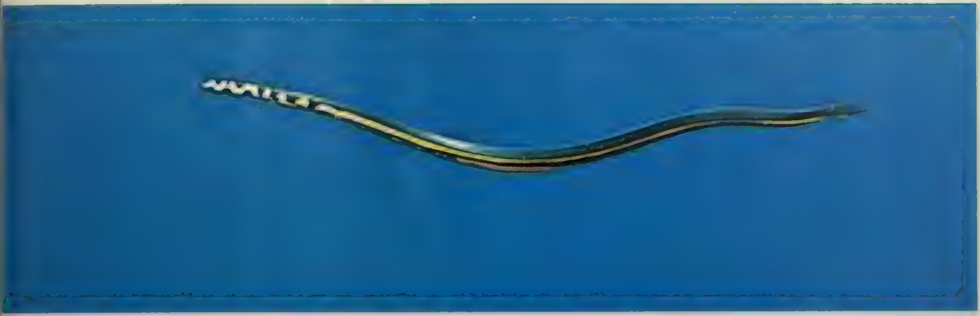
Sea snake bites are frequently not fatal, however, because of the snakes' apparent reluctance to inject venom even when they do bite. Only about one-quarter of those bitten by sea snakes ever show signs of poisoning. The purpose of withholding the venom is unknown, but whatever the explanation, we should be grateful, for sea snake venom is the most potent of any snake's. H.A. Reid, an authority on snakebite in Malaya, compared the toxic effect of the dried venom of a sea snake (*Enhydrina*) with that of three of the most deadly land snakes—the common cobra, the tiger snake, and the death adder. When injected under the skin of rats or rabbits, the sea snake venom was about two to ten times as toxic as that of the land snakes. But when sea snakes do inject venom, they deliver less of it than do land snakes. This may be of little consolation, however, unless you are the second or third person bitten by a particular snake: one scientist has calculated that the venom ejected by one fresh adult sea snake is enough to kill three men.

For North Americans the main hazard from sea snakes will arise if they are allowed to swarm into the Caribbean and tropical Atlantic through the proposed Panamanian sea-level canal. A specially appointed Committee on Ecological Research for the Interoceanic Canal has agreed with my prediction that the yellow-bellied sea snake would be able to move through a sea-level canal and reach the Atlantic Ocean. This would be ominous for the Caribbean resort trade, because tourists are unlikely to want to share their place in the sun with a dangerous snake. Live sea snakes could be washed ashore in Trinidad, Nassau, or Miami Beach.

The effect of the snake's presence on man might be only one of the problems caused by its entry into the Caribbean. Rubinoff's studies on the interaction between predatory fish and sea snakes indicate that the snakes might eliminate large numbers of Atlantic fish. In some of his tests sea snakes were swallowed by captive Atlantic fish and then later regurgitated alive as the fish died from the effects of a bite. Thus one snake might kill more than one unsuspecting predatory fish.

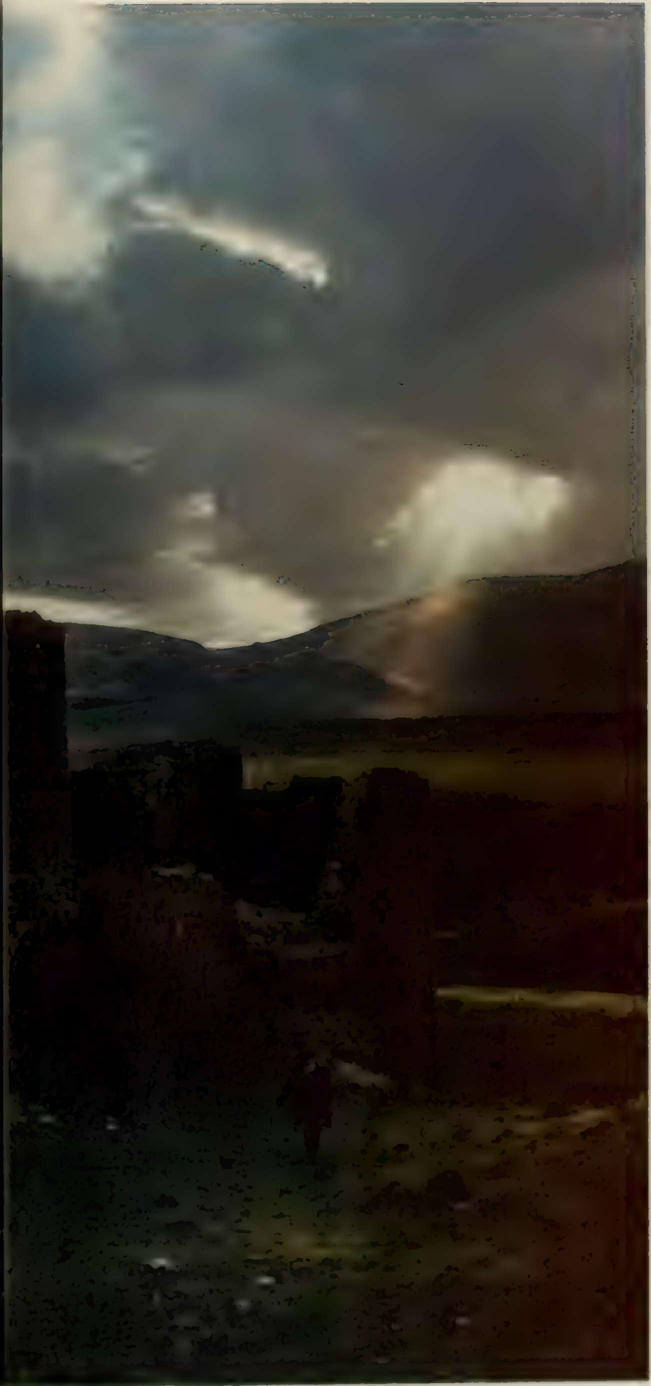
Other potential canal migrant could be even more dangerous t the ecology of the tropical Atlantic We only have to look at the histor of the introduction of alien specie into new environments to see ho much damage can be done. Th construction of the Welland Cana between Lake Erie and Lake Ontario allowed the movement of lampreys into the western Great Lakes resulting in the decimation of lak trout. Other introduced species tha have become nuisances in thei adopted homes are starlings, hous sparrows, pigeons, and carp in th United States, rabbits in Australi and Hawaii, goats in New Zealan and the Galápagos Islands, and th mongoose in Jamaica and Hawaii The financial and ecological damage done by these and similar introduced pests is staggering. A more alien species become established in an area, the complex we of ecological relationships betwee the native animals and plants becomes strained and may break i places, causing extinction of som native forms. The demise of most o the unique Hawaiian birds can b directly traced to the introductio of alien species.

The proposed sea-level cana could involve the mixing of specie on an unprecedented scale, and n one can predict the consequences. As a biologist, I find the risk of catastrophe so high that construction of the canal must be opposed. Ther is a slight hope of creating barrier in the canal, of temperature perhaps, to prevent interocean movements. This could be effective against the sea snake because it is very sensitive to high temperatures. But many other organisms may not be so sensitive. In weighing the alternatives and considering possible damage to the environment, the massive costs of a sea-level canal, the expected benefits from the new canal, and the costs and benefits from enlarging the present freshwater canal, I must conclude that construction of the sea-level canal would be a disaster of the first magnitude. The sea-level canal should not be built and the yellow-bellied sea snake should be kept in its rightful and natural place in the Pacific.



A yellow-bellied sea snake drifts with the currents in Mexican waters. They are easier to find on rainy days, when they do not dive frequently to cool off.

The existing Panama Canal uses massive lock gates. The principal barrier to migration across the canal, however, is the freshwater lake in the middle. Any sea-level canal would lack such a barrier.

# The Road to Ani

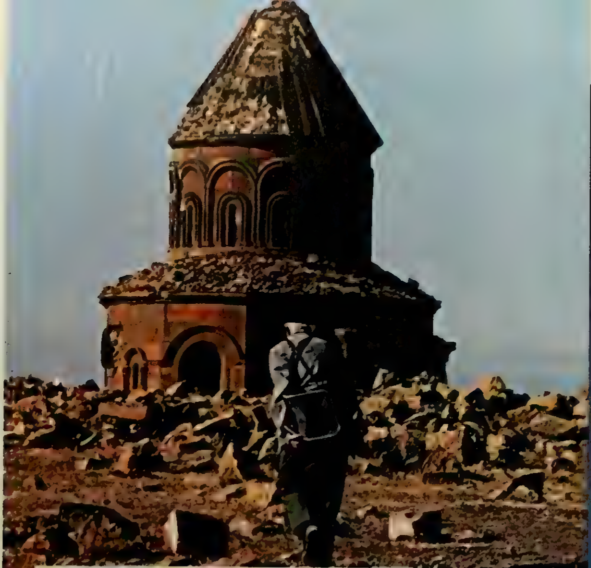
Armies marched through Ani for thousands of years; their history is writ in the stones of a dead city

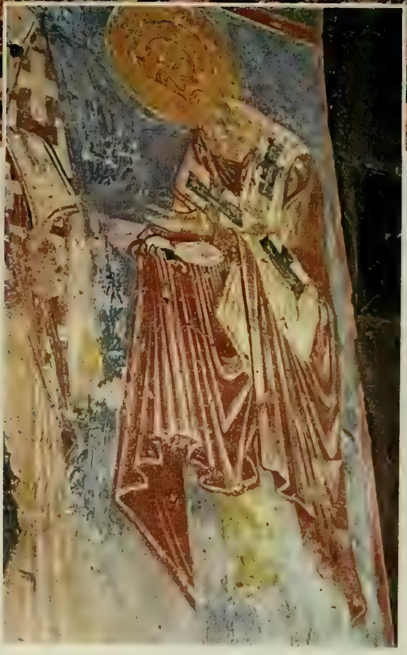
by Charles E. Adelsen

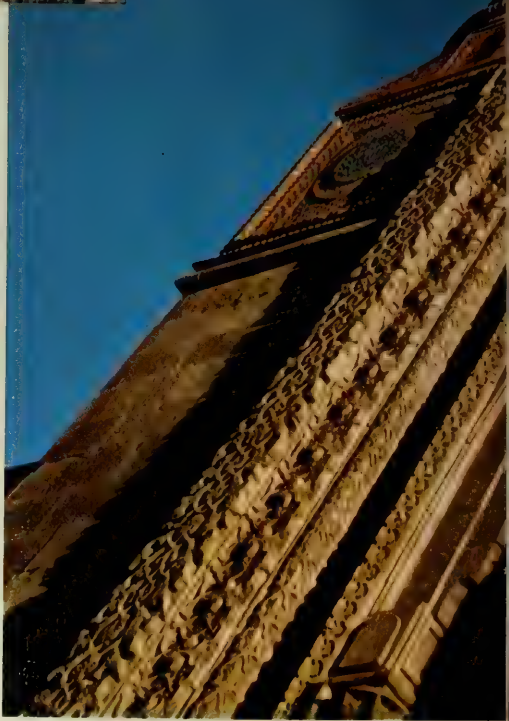
Ani, the ghost capital of medieval Armenia, stands balanced on the cliffs over the Arpa Çay where the river marks the Turco-Soviet frontier. The land around it is as magnificently forbidding, and about as bare of the mechanized aspects of civilization, as it was when Persians, Romans, Byzantines, Arabs, Seljuk Turks, Georgians, Ottomans, and Russians first tramped across its rugged hills and cold upland plains on their way to conquest and settlement.

Properly, the road to Ani begins at Erzurum, within living memory a westward-facing bastion of Russian

Three and a half miles of walls and towers surrounded what was once the fortress city of Ani. Little is left inside except churches.





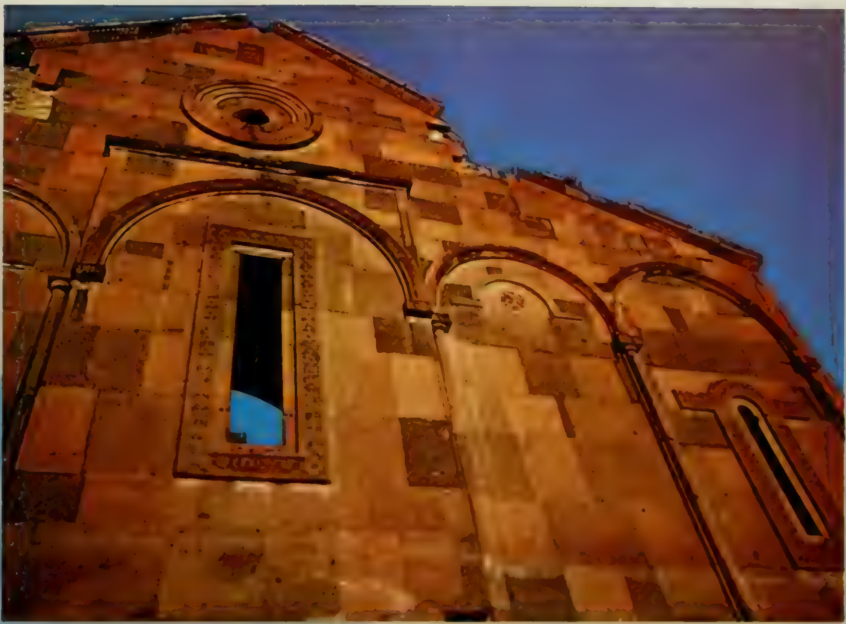


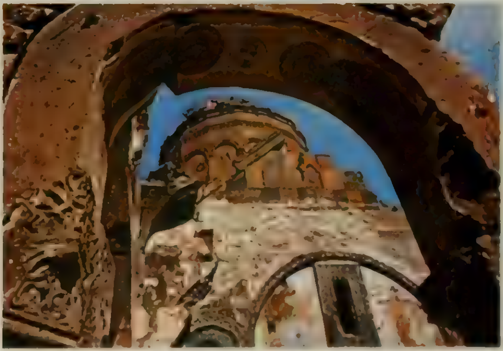
The Chapel of St. Gregory, top, has touches of Byzantine and Gothic architecture. A fresco of a saint has survived the centuries well. In Erzurum stands the Double Minaret Theological School, right, built in 1253.

empire-builders and now a primary center of the eastern land defenses of the Turkish Republic. Long an important link in the silk route, Erzurum has acquired that peculiar homogeneity of look that might be called "Turkish modern." From Erzurum the route leads to Kars, built as a model city by czarist Russia in the nineteenth century. It was at Kars that we had to stop to have our papers approved by the police and army before proceeding further into the military zone. From there to Ani, we were never out of sight of the army.

After having been checked and rechecked at recurrent sentinel posts during the hour's drive to Ani, we caught our first glimpse of dark battlements sprawling against the clouded horizon. The walls of Ani. There is an inescapable feeling of having come upon a living city. Especially from far off, the walls seem almost intact. The reaction is that of having come upon some Camelot set in a wasteland, and you wait for a challenge to come down from those high towers with their extraordinary black crosses set in an expanse of rose-colored volcanic stone. But Ani is dead, and ha been since the fourteenth centur when an ultimate terrible earth quake exiled its last citizens fror their ancient town. Nature wrot *finis* to Ani's drama, something tha conquest and occupation by Byzan tines, Seljuks, Georgians, an Mongols had never really done.

The Jeep's motor was quiet a last, and the silence, accentuated b the twittering of a bird in the grass was the silence of a wilderness. Ye we know that a hundred thousan souls lived here once and that An boasted—doubtless with Eastern hy





The architectural zenith in Ani was reached with completion of the cathedral, left, in 1010. Only the top of the building is visible here. In the close-up, top, details of the same façade can be seen. In the Church of St. Gregory, immediately above, a porch reflecting Islamic influence has been added to what was once a Christian church.

erbole—that Mass was said in a housand and one churches.

Where the relief figure of a lion igorously strides across the middle ate, we entered Ani through what vere once double walls, strongest lefenses of a city also protected by he confluence of the ravines of the rpa Çay ("Barley Stream") and he Alaca Çay ("Many-colored tream"). These walls defended ni's only really vulnerable feature, s frontage on the rolling plain of ars, the logical area for attack by he land armies of medieval times.

A close look at what from a disance seemed to be wholly preerved walls reveals the sad truth. he decay of Ani has been accelrated in recent years not just by arthquakes, war, or the slow attriion of ice and frost—although the ouch of all of these seems evient—but by the hand of man to hom Ani is only a gigantic stone eap for the building of his rude rmhouses and fences. The lower ourses of superbly worked stone ave been pried away and carted ff, revealing the inner fill of conlomerate. Within the city, hurches, mosques, even the castle ll show the same despoilment.

A nineteenth-century visitor reiarked how the façade of the soalled palace was even at that time eing stripped of its stone mosaics, ot by the ignorant, nor by the macious, but by what he termed—no oubt with conscious irony—"patritic Armenians." Photographs iken at the time, compared with ur own pictures, show what seven r eight decades, a blinking of the ye in Ani's long history, have done to both Christian and Islamic structures.

Within Ani's tremendous walls and the gorges of its protecting streams, we found ourselves in the precincts of a once teeming city where today the loneliness is utterly palpable. Man and nature, especially the latter, have swept away every feature of the humble dwellings of Ani's vanished population. Homes were undoubtedly built of the same fragile stuff—stone and mud—that the plainsman and highlander build with today. The effect has been to isolate the more durable public buildings, making their inspection all the easier.

There is no such thing as a simple recapitulation of Ani's history, just as a simple résumé of the whole history of Armenia itself is impossible. Stability in the broad land existed, whenever it did, under the aegis of tyranny. Interregnum periods were typically chaotic. The Armenians had chosen, fatefully, to build their house in the middle of a busy highway. The consequences form the stuff of their Jeremiah-like chronicles.

Speaking an Indo-European language, the Armenians were thought by Herodotus and others to have migrated to Anatolia from Thrace with the Phrygians. These proto-Armenians supposedly settled in the ancient lands of Urartu sometime early in the seventh century B.C. The latter-day conflict of Turks and Armenians was only episodic in a centuries-long series of confrontations in which the Armenian native found himself, at best, the citizen of a buffer state wedged between superpowers. In worse times, he was athwart the line of march of resolute conquerors. Pertinently, the most eloquent outpourings of Armenian wrath were at first directed not at the Moslems, but at the heads of the "Greek" Byzantines, whom the Armenians accused on the one hand, of usurping their freedom and on the other, of ultimately emasculating them and leaving them to their fate.

In the tenth century A.D., Armenians were able to assert their sovereignty, at least nominally, as the whirlpool of Armenian history stilled itself for a while. Both the emperor at Constantinople and the caliph at Baghdad sent crowns, emblems of self-government, to Ashot II the Iron, called "king of kings," and the country entered a brief and precarious Golden Age. The great monuments of Ani belong to that time. The reigns of Ashot III the Merciful (951–977) and Sembat II (977–989) were the apex of that age. With the coronation of Ashot III, Ani stepped up from her position as a strategically placed fort, becoming the real capital of the Armenians. Her fortifications were strengthened, and the people's talent in architecture expressed itself in magnificent royal structures.

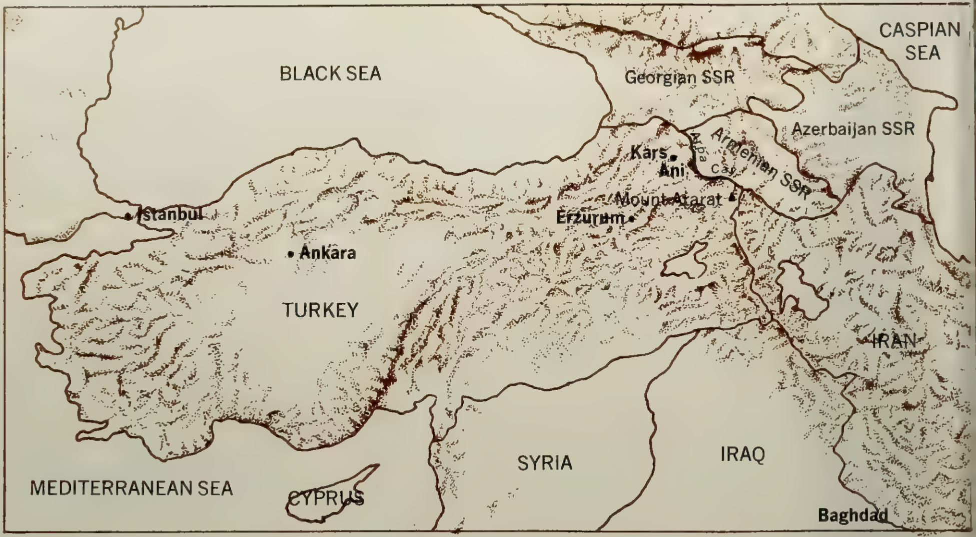
By the command of Sembat II the outer defenses were built and the foundations of the cathedral were laid. The great church was only completed, however, under Sembat's brother, Gagik I (989–1019), and then largely as a result of the efforts of Gagik's queen. Under Sembat, the Armenian patriarchs moved their seat to the city on the Arpa Çay.

With his death, Gagik's sons plunged the land into civil war. Unity suffered a blow from which it would never recover as the all-important feudatories of the no longer solid state showed themselves increasingly independent. At last, rule of Armenia was divided among four kings, including one at Ani. Faced by the irresistible mounted archers of the Seljuk Turks, Armenia compromised her independence, and in 1022 John Sembat, king at Ani, was persuaded by the Byzantines to will his country to the Emperor Basil II.

Fierce resistance by at least some of the Armenians to this Byzantinization followed the death of Basil, but at last a Greek-speaking governor sat at Ani in the name of a distant emperor. Even that symbol of strength was short-lived. Oppressed by their own difficulties, and with a wasted treasury, the Byzantines left Ani to its own wits, an act for which Armenians down the ages have labeled their fellow Christians perfidious.

In the short, flowery summer of the year 1064, Alp Arslan (Alp the Lion), a figure known to Turks for his chivalry and bravery, attacked

rches supported by
oupled pillars lead the eye
o where a dome once capped
he cathedral. The style
as a Gothic flavor, but
he church was built 100
ears before the Gothic
tyle appeared in Europe.

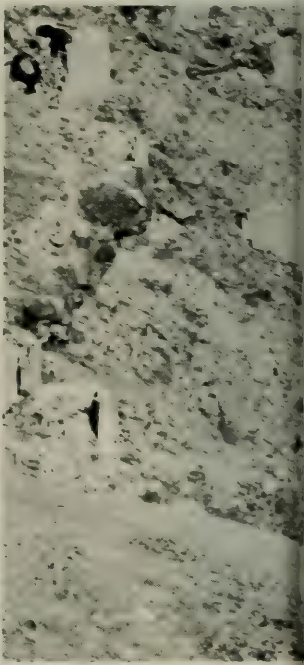


Ani from the plain. After twenty-five days of siege, the city saw the horse-tailed tug of the Seljuk sultan brought ceremoniously into the capital. Ani's Golden Age was over. Ahead of the Seljuk Turks lay the road to Malazgirt, where in 1071 they defeated the Emperor Romanus IV Diogenes and a huge Christian army in one of the world's decisive battles.

In bewildering succession, Ani was ruled by a dynasty of Kurds—who acquired the city as a fief from the Seljuks—then by a Bagratid dynasty of Georgian kings; the Kurdish dynasty was restored; the Georgians came back; Moslems again ruled Ani; and at last the Mongols galloped through Ani's gates in 1239. The search for traces of all these peoples in these highlands may be left to the physical anthropologist. A fascinating, if endless, assignment! The architecture of Ani provides a more accessible record of so many successive rules by such disparate peoples as Armenians and Mongols.

The importance of the cathedral, paramount surviving structure at Ani, lies as much in its identity as a milestone on the way toward the later development of the Gothic style in the West, as it does in its own near perfection of execution and form. When the first Mass was celebrated in Ani's cathedral in 1010, Gothic architecture had not evolved in the world. The Romanesque style reigned supreme in the West. Yet entering the cathedral today, anyone with even the slightest acquaintance with the great Gothic churches of Europe encounters something strangely familiar: the narrow aisles beneath the soaring roof lead one forward to the apse as the eye discovers the powerful columns with their coupled piers rising to the now-vanished dome. Similar piers rise at opposite ends of the church. Seeing the pointed arches overhead, the ribbed vaults, one automatically thinks "Gothic."

Armenian architects were well enough thought of in the West that one of them (in fact, Tiridates, who designed the cathedral of Ani) was summoned to Constantinople to repair major damage done to the



This picture of the Arpa gorge was taken with a telephoto lens because of military restrictions. Turkey is on the left bank, with the USSR on the right.

ome of Hagia Sophia by an earthuake. Whatever influences must ve flowed mutually between Byntium and Armenia, one characristic, so highly evident at Ani, rdly showed itself in the Byzane art of building. The structures Ani delight the modern eye with eir sophistication of exterior degn—a polished symmetry carried most to the point of predictable, if alted, stylization. The typical ne and brickwork of a Byzantine çade seldom achieves such an efct. Perhaps the difference in exetion was philosophical: to the Byntine, the shell of the structure s to the interior what the corruple body was to the soul, a tempol housing for the mysteries of the irit. Hagia Sophia at Istanbul asunds first with the marvel of its gineering, before one discovers e beauty of its art. Ani's caedral, however, impresses with its veliness, its symmetry within and thout, before one wonders about e details of its construction.

Nearby stands the Church of St. egory, named for the "Illuminator" who converted the Armenian nation to Christianity more than a century before Theodosius I forbade pagan devotions in his realms. The church sits high on the eastward-facing bluffs of Ani, with the gloomy, turbid stream of the Arpa rolling far below.

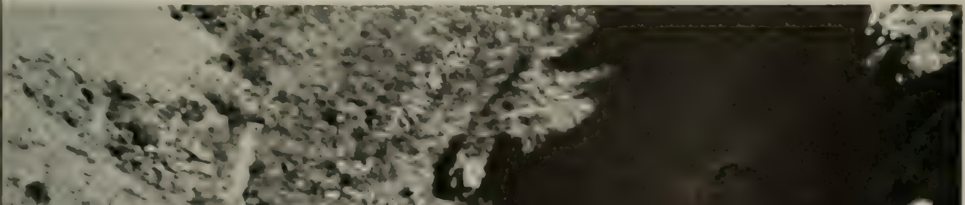
From St. Gregory's, we saw peasants of the Soviet Republic of Armenia at work in the fields overlooking the Arpa's eastern banks. Their voices, and now and then a drift of song, were blown by the wind across the gorge. A soldier wearing a beret and carrying what looked like a Sten gun patrolled while the peasants worked amid the grain.

The tableau of the Turks and the Russians facing each other across the Arpa Çay is the essence of history in the making. Georgian script, along with elongated figures of El Greco-like saints decorating St. Gregory's walls, recall an earlier dramatis personae of Ani's history, the period of Georgian rule. And the porch, a later addition to the church, shows its Islamic style even while the pillars suggest the yet-to-be-born Gothic.

The conic dome of the Church of St. Gregory has been lightened by the inclusion beneath its stone facing of hollow earthenware vessels. The origin of such domes—one sees them in Seljuk mausoleums as well as in Armenian and Georgian churches—has inspired much speculation. The modern traveler Lord Kinross saw their prototype in the cone-shaped stacks of dried animal dung, the *tezek*, standing in eastern Anatolian farmyards.

Another, more plausible theory holds that the great cylindrical felt tents of central Asia, those that could be moved about on wheels behind multiple teams of oxen, were the real prototype of the peculiar shape of both the mausoleums and churches. According to the same theory, the relief decoration on Seljuk tombs reproduces the felt-appliqué designs of the central Asian tents of Turks and Mongols.

One who has traveled today in eastern Turkey might conclude that both the round tent and the cone-



shaped heaps of *tezek* represent a common response to an environment of wind and driven snow typical of the eastern Turkish highlands and central Asia. "Structures" composed of streamlined surfaces would be less vulnerable to such a climate than those made of resisting planes.

Another religious edifice named for the Illuminator is the Chapel of St. Gregory, built while Ani still had her own kings. At one time the twelve-sided chapel was the repository for the remains of the Pahlavuni family, one of whose members led an uprising to protest the ceding of Ani to the Byzantines. He survived that, but died in battle fighting the emir of Dvin. The inscriptions in the chapel, as on other buildings of Ani, are curiously free of the Eastern grandiloquence one might excuse in so persevering and proud a people. The inscriptions report family burials or record how the income from some business enterprises in the town should pay for Masses said for the dead. The style here, too, includes hints of the still unconceived Gothic.

What is left of the beautiful Chapel of the Redeemer, another relic of the rule of the Armenian kings, is so covered with inscriptions that one suspects that here were a people who utilized the decorative possibilities of their script in much the way that Moslems made a special art of their own calligraphy. The Armenian letters, devised at the start of the fifth century A.D., are always so neatly executed, they give the appearance of well-designed typeface. The letters add to the elegance of a structure, even if their meaning is hidden from those not familiar with the language. Here, they tell how a piece of the true cross was obtained at Constantinople in 1034 and enshrined in the chapel, where each night prayers were to be said until Christ came again. About half of the chapel has collapsed, the interior yawning hollowly in the direction of the Soviet Union.

On a slight rise are the ruins of what must have been a building massive as a fortress—the synod house. As the center of church administration, carrying on the practical business, it would have seen convocations of black-cowled bishops presided over by the patriarch. Huge, lichen-covered, double-headed capitals must have surmounted truly enormous piers. The synod house, like so many Armenian structures, was apparently round, and we may imagine the princes of the church gathered in a circular seating arrangement.

What has been called "the palace" (simply a barracks building) is situated up against the northwest defenses of the city. It is the same rugged structure that was being robbed of its star-shaped mosaics by its admirers in the last century. Inspired by the palace folklore, local inhabitants tell travelers that it was, in fact, the *sultan-sarayi*, or "sultan's palace." A French *Souvenir d'Ani*, printed in 1904, identifies it simply as the *Palais des Bagratides*, with pictures of the edifice entitled *caserne* (followed by a question mark), indicating that this might have been the barracks of the supposed palace. There are no inscriptions at all, and it is a case of traditional belief—or wishful thinking—asserting itself.

Facing the ruin of a single-spanned bridge that once joined the banks of the Arpa Çay is the most prominent reminder of Moslem rule at Ani, a mosque upon whose minaret is encrusted, brick upon stone, the word *Bismillah*, "In God's Name."

If Ani is a veritable maelstrom of human interminglings in the floodtide of movement across Anatolia, its cosmopolitan character expresses itself most completely in the Church of the Apostles. Once a three-domed edifice, only the section covered by the easternmost dome remains. But it is an eloquent ruin. Church it is, with the peculiarly intricate Armenian cross carved elaborately upon its pink volcanic stone. Yet the stalactite motif seen in a remaining entrance, and even its whole plan, would proclaim it, were it not known otherwise, to be of purely Moslem inspiration. Since its earliest inscription dates from the time of the Armenian kings, it would seem that, in detail at least, it was altered under Moslem rule. Other inscriptions recall the government of the Georgians or the overlordship of the Mongol suzerain.

Of the popular dwellings of Ani, nothing, as has been remarked, remains. But the canyon of the Alaca and the lesser canyons leading to the gorge of the Arpa Çay have been extensively and anciently riddled by caves that were once human habitations. Since the hundred thousand citizens of Ani can scarcely have all resided within the walls, and since houses at least partly subterranean are still, out of fear of the winter and for scarcity of building materials, inhabited in parts of eastern Anatolia, it is possible that some of the Anians normally lived in such caves.

The dramatic history of Ani is given a final lugubrious touch by a traditional belief that the innumerable caves are visited by the unquiet souls—the voice of the murmuring river—of those who centuries ago were the flesh and blood of Ani.

Where the palace of Ani might have risen, on a mound affording a clear view of the Russian bank of the Arpa Çay, the flag of the Turkish Republic, small, as man himself appears small in so vast a landscape, flies in a strong east wind. As we left Ani, shafts of sunlight poured from a sky of dark or incandescently edged storm clouds, shade and light alternately sweeping across the city and giving it the apocalyptic look of a Doré engraving. Behind that Turkish flag marched the whole procession of kings of kings, emirs, sultans, and Mongol overlords who once held the scepter of Ani in their hands. At few other sites on earth is the impression of man on the land so multiform.

Only part of the Chapel of the Redeemer still stands, with its finely worked inscriptions halfway up what is left of the building.

THEY'LL DIE

unless you and we help them. They'll Die—and thousands more like them of many different species will die—unless money is made available to finance the many requests from East Africa's National Parks, Research Organizations and Game Departments.

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The Strange, Unfinished Saga of Peking Man

Continued from page 18

One problem that surfaced early was the relationship that Peking man bore to the then only other generally accepted early man—*Pithecanthropus.* Black's identification of his finds as a distinct group was challenged by the distinguished anatomist Le Gros Clark, who claimed that both *Sinanthropus* and *Pithecanthropus* belonged to the same species. A minor controversy between Clark and Weidenreich on this point proved of little consequence since they were fundamentally in agreement. Weidenreich, in his study, recognized the close relationship of the two types and compared their distinguishable differences to the racial distinctions among various groups of mankind today.

The dating of Peking man has never been as conclusive as one would like. One difficulty is that estimates on dates of the Pleistocene have varied with new geologic interpretations. Another difficulty is the precise placement of Peking man in the Pleistocene by associating him with extinct animals whose time spans are also subject to variation. At present, scientists generally agree that Peking man lived in the mid-Pleistocene (somewhat later than Black's estimate), probably during the second glaciation. One interpretation extends the Pleistocene period for two million years, which would date Peking man back about one million years. On a more conservative scale, Peking man lived 500,000 years ago. These dates may be modified as new data become accessible. Even now, recent paleomagnetic studies by Allen Cox suggest that Peking man might be dated at 650,000 years ago.

Since Weidenreich's time, another important reorientation has occurred that has affected the attitude toward *Sinanthropus.* This is the recent accumulation of australopithecine and related fossils from Africa. The first of these, although known to Weidenreich, played no part in his assessment of Peking man, since he and many others regarded it as rather apelike. Today the relative abundance of these hominids has clarified the picture. They are a much earlier form of manlike creature and existed as far back as four to five million years ago. Thirty to forty years ago *Sinanthropus* and *Pithecanthropus* looked very primitive to our eyes; now, contrasted with the far earlier African forms, they are well-developed hominids, very close to *Homo sapiens.*

A gap remains between Peking and modern man. Weidenreich and others have filled it in with Neanderthal man, whom they regard as the logical transitional stage between the two, just as *Sinanthropus* and *Pithecanthropus* partly fill the evolutionary sequence after the African australopithecines.

Weidenreich was also struck by a number of anatomical characteristics of the Peking skull and dentition that are remarkably similar to those found among the Chinese and other Mongoloids today, but that are rare or nonexistent in other racial groups. From these comparisons he concluded that Peking man, if not the exclusive ancestral group of the living Mongoloids, must have played a major role in their evolution. He envisaged human evolution toward *Homo sapiens* going on simultaneously in various parts of the world, thus leading to some extent to the production of the geographic distinctions that exist among modern man.

When word reached us in December, 1941, that the Peking fossils had disappeared, the manner of their loss was uncertain. Conflicting accounts trickled through. Appeals to official sources in Washington for more reliable information were completely fruitless. One thing was clear: the Peking Union Medical College authorities had reconsidered what to do to insure the safety of the fossils as war between Japan and the United States became increasingly imminent, with its threat to American institutions such as the Peking Union Medical College. One story was that the fossils were packed in boxes and shipped to the coast to be transferred to the S.S. *President Harrison.* As the lighter with its precious cargo was being unloaded, it somehow tilted, and the boxes slid into the harbor and were lost.

Another story, which made a bit more sense and which we tended to

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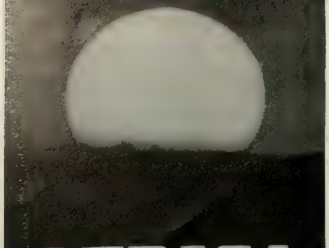

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accept, was this. Shortly before Pearl Harbor, the Peking Union Medical College officials approached the U.S. Embassy for aid in transferring the fossils to the United States, since by then any other plan seemed impractical. The Embassy assigned a number of boxes containing the specimens to the charge of the last group of U.S. Marines to be evacuated before the Japanese took over all installations in Peking. The story went on to relate that en route to Tientsin, the train bearing the marines and their baggage was halted by Japanese troops who ransacked the luggage, including the boxes containing the fossils. As a result, they were scattered and lost.

Another version of this, reported by *The New York Times* on January 5, 1952, relates that the then commanding officer of the Marine contingent at Peking, Colonel Ashurst, had sent the fossils in footlockers to Chinwangtao where they arrived safely. According to this account, the train with its freight, including the footlockers, was captured by the Japanese.

Since this took place at the outbreak of hostilities with Japan, there was little hope of discovering the truth or of recovering any of the apparently dispersed fossils. We reluctantly resigned ourselves to the situation.

After the war, Weidenreich, stimulated by a success story in which Dr. Walter Fairservis (presently associated with The American Museum and a professor at Vassar College) played the chief role, tried again in 1947–48 to determine the circumstances of the loss and the possibility of finding the missing specimens. Shortly after the war had ended, Fairservis, a former student and a friend of mine, had written to me from Japan where he was engaged as a lieutenant in the Foreign Liaison Service of the U.S. Army. In his letter he asked if he could do anything for me while he was there. Mostly in jest, I suggested he try to find the Solo skull that the Japanese had stolen from Professor von Koenigswald's collection in Java when he was sequestered in a prison camp for the duration of the war. When, a short time later, I received a request from Washington for a description of this late Javanese fossil, I immediately,

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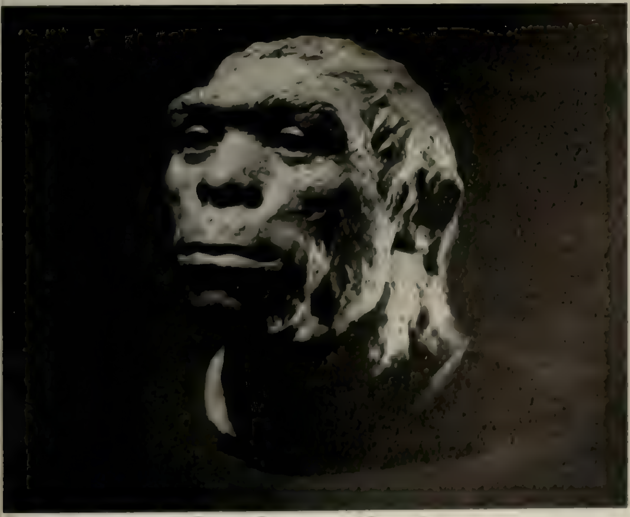
but almost increduously, began to suspect that Fairservis was on the trail of something. Two days before Christmas of 1946, he met me at the elevator of the Museum, bearing a box in his arms. He had been sent on a ship, rather than on a plane, from Japan to insure the safe delivery of the lost "ewe lamb" to von Koenigswald, who was at that time a guest in my laboratory. Fairservis had found the skull of Solo man in the Japanese emperor's Household Museum.

Encouraged by this fantastic success, Weidenreich tried to get Fairservis assigned to the Peking mystery. But unfortunately nothing could be arranged. I do not know why interest could not be aroused in Washington. Possibly the precarious situation of Chiang Kai Chek's Kuomintang government was the discouraging factor.

Another reverberation set off by the loss of the Peking fossils reached Dr. Weidenreich late in 1945. In November of that year, Frank Whitmore, a staff geologist with the U.S. Army in Tokyo, wrote the following to Dr. Tilly Edinger at Harvard: "November 8—We have just recovered at Tokyo University a collection of bones and artifacts from the famous *Sinanthropus pekinensis* site at Choukoutien, near Peking. Also the original records of Davidson Black's research there. Also the complete original plans of the excavation and their financial records 1927–1938. We want to return all this to its owner, Peking Union Medical College, and today I'm going to scour around to see how best it can be done." Two weeks later Whitmore wrote in more detail: "But speaking of publicity the *Sinanthropus* deal is really hot stuff. . . . I went out to Tokyo University where the collection was, and saw Professor H. Suzuki about it. He said he didn't know anything about it. I asked him the same question again . . . and he said, well, he *had* heard of it but didn't know where it was. I asked him a third time, and he hissed—said he'd go and look around. He was back in five minutes with the collection, which includes some chipped stones and blacked antlers, found with the *Sinanthropus* bones, and many more advanced implements and ornaments from higher levels in the Choukoutien cave. . . ."

The bones and artifacts that Whitmore found at Tokyo were from a late level at Choukoutien and were presumably not considered precious enough to be shipped off with the *Sinanthropus* fossils. But this discovery in Tokyo confirmed the fears that the fossils would have been taken by the Japanese if they had been left in Peking.



Reconstruction of *Sinanthropus pekinensis* by Harry L. Shapiro

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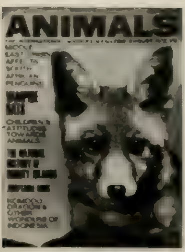

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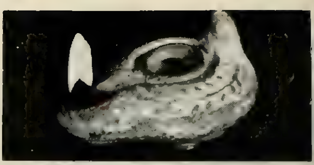
And the last minute effort to move them to a safer lodging now was clearly well justified.

Yet, in the light of Dr. Whitmore's success in recovering some of the Choukoutien material, the safer course might have been to have left the fossils in Peking. In that case they would have been collected by the Japanese as rare booty and transferred with every caution for their safety and preservation to Tokyo where Dr. Whitmore might have recovered them. As a final thought on this course: What if our atomic bomb had exploded over Tokyo instead of Nagasaki?

One other version of the fate of the relics of Peking man surfaced in March, 1951, eighteen months after the Communist government had taken over China. It involved me in a very personal and totally unexpected way. At that time, the Communist press printed a story that charged The American Museum of Natural History with secretly acquiring and storing the fossils. As chairman of the Department of Anthropology, this placed me in a questionable position. The item was picked up by newspapers around the world, and *The New York Times* carried the account. I immediately issued a complete denial, which *The New York Times* printed. In the following year the same story was broadcast from China at least two more times. I didn't bother to deny the later versions since the repetitions began to look like convenient propaganda. And I assumed that any reasonable colleague reading such nonsense would realize the absurdity and futility of such an allegation. What could one do with such world-famous specimens if they had been illicitly acquired? Any exhibition or scientific use of them would have been like exhibiting a stolen Mona Lisa. And surely they had no aesthetic appeal that might have gratified my solitary enjoyment of them.

I did uncover a clue, however, to the way this story may have originated. Shortly before Weidenreich died, he had been visited in his laboratory by a well-known English paleontologist, Prof. D.M.S. Watson. Watson told me that on his return to London he had invited some of his graduate students to tea in his office, where he described some of the interesting things he had seen



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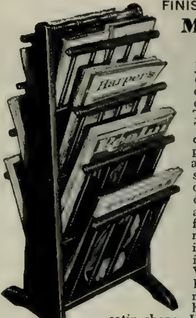

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in the collections at The American Museum of Natural History. He mentioned that he had called on Weidenreich, who had shown him the skull of Peking man. Watson later explained to me that inadvertently he had not made it clear to the students that Weidenreich had shown him casts of Peking man, not original fossils. One of the young men, a German with Communist leanings, later left London and went to China. Watson concluded that his former student told some Chinese paleontologists that Watson had seen Peking man in the United States—not knowing that the skull was only a plaster replica.

In the decades since their disappearance, we had, I think, all become more or less reconciled or resigned to the irretrievable loss of the original Peking fossils and felt that the true story of their fate would never be established. Some slight softening of the blow has occurred in the past decade by the renewed excavation of the Choukoutien site by the Chinese, who have uncovered some new fossils of Peking man. But those are only a small fraction of the number in the original collection.

And then in April of this year we received a telephone call at the Museum from the office of Dr. William T. Foley, a distinguished heart specialist in New York City. Mr. Herman Davis, his assistant, was inquiring about Fairservis and his attempts to investigate the loss of the fossils back in 1947–48. He wanted the name of the officer with whom Fairservis had corresponded. This led to the totally unexpected and dramatic announcement that Dr. Foley was the Marine officer to whom the fossils had been assigned for transfer out of China to the United States in December, 1941, and that Mr. Davis had handled the boxes containing the specimens. These two men knew firsthand what had happened. Now, 30 years after the event, Dr. Foley, writing an account of his involvement with Peking man for his memoirs, was checking information. I immediately arranged a visit to Dr. Foley's office on East 68th Street to get the details of what had occurred. The gist of that story follows; the details are recorded on tape.

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Japan and the United States, Dr Houghton, director of the Pekin Union Medical College, conferre with Colonel Ashurst, who was i charge of the U.S. Marines in th Peking area, about shipping the fossils out of the country. Colonel Ashurst and the entire Marine detachment in the Peking area wer scheduled to leave for Manila o December 9. Dr. Foley, then a Marine medical officer stationed a Tientsin and a research fellow a the medical college, would have accompanied the detachment to Manila in any case. But since he ha spent three years on duty in Chin and his term was up, he was scheduled to proceed from Manila to hi home in New York City. For tha reason, Colonel Ashurst had ordered Dr. Foley to carry with hi in his personal baggage the endangered fossils.

Although Dr. Foley had see some of the fossils being packed i large glass jars and placed in standard footlockers at Peking, he wa in Tientsin when the operation wa completed and ready for shipment. Some of these boxes were labeled as his personal luggage with his name attached to them. Some, it appears, carried the name of Colonel Ashurst. I have been unable to discover the basis for such a division or the reason for it. In any event, the footlockers bearing the names of these two officers were sent as personal luggage directly to Chinwangtao, the port city where the S.S. *President Harrison* was expected to pick up passengers for Manila.

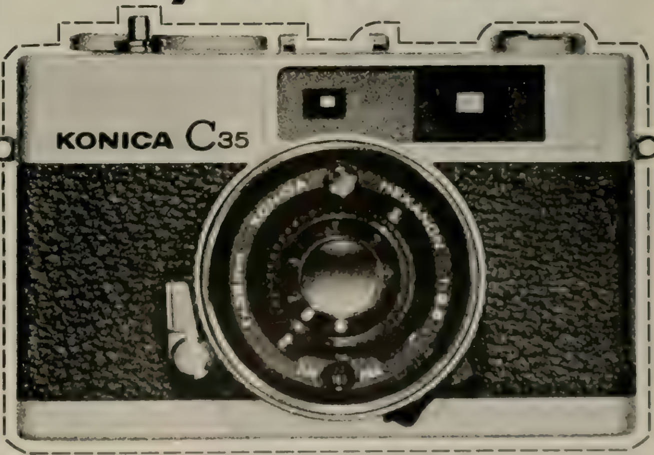
Mr. Davis, then a pharmacist's mate in the U.S. Navy, was stationed with seventeen Marines in Dr. Foley's unit at Camp Holcomb in Chinwangtao. He was asked by Dr. Foley to receive the boxes sent in his name to Chinwangtao and take care of them as personal baggage. On December 8, the day after Pearl Harbor, Davis had already unloaded Foley's baggage and piled it in his room at the camp. That morning they were surrounded by Japanese soldiers, a Japanese cruiser appeared in the harbor, and overhead, six Japanese planes were sighted. The Japanese called on Davis and his companions to surrender. But in the tradition of the Marines they at first refused and were preparing to resist. Davis had stacked the Foley baggage as a nest with his machine gun on top, ready for use, unaware of the danger to the fossils if shots were exchanged. It ended quietly, however, because after radioing to Peking, they were ordered to surrender.

Before herding the marines off to Tientsin, where they were to be temporarily imprisoned, the Japanese permitted each man to take a single bag of personal belongings. Their remaining boxes and trunks were to be sent on later. Davis had no idea that the Foley baggage, which was among the goods left behind, contained fossils, since he had not opened any of Foley's luggage. A week or two later, the Japanese deposited among the imprisoned marines at Tientsin a jumble of personal effects, all mixed up. They had opened the boxes left behind, ransacked them, and sent on the personal clothing and other effects, which Davis then sorted out, unaware that the fossils had not been forwarded. Davis is of the opinion that whatever fossil specimens the Japanese may have found would have been discarded in the vicinity of the Camp Holcomb buildings.

Dr. Foley told me that on the day war broke out, he had been immediately placed under arrest. He was transferred to the Marine barracks for about a week, but was then permitted to return to his house in the British Concession and allowed semidiplomatic status, which gave him the freedom of the city. Sometime later he received from Chinwangtao boxes labeled with his name. Some of these contained personal effects, others he recognized as boxes assigned to him from Peking.

I asked Dr. Foley why the boxes bearing his name were delivered, apparently intact, while the boxes belonging to the marines from Camp Holcomb had been opened and rifled, and their contents delivered in mixed-up bundles. He replied that he had opened his personal boxes and found that several skulls he kept as anatomical specimens, as well as a Chinese Buddha figure, were missing. The footlockers assigned to him from Peking, he had not examined. That the boxes had been sent to him but not to the marines he attributed to the customary Japanese courtesy and respect for rank.

Faced as he was with the pros-



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pect of internment, which in fact came shortly and lasted for four years, Dr. Foley decided to distribute the footlockers from Peking bearing his name in various depositories for safekeeping. Some went to the Swiss Warehouse and the Pasteur Institute in Tientsin and some were placed with Chinese friends on whom he could rely.

Subsequently Colonel Ashurst, Dr. Foley, and their fellow officers lost their diplomatic status and were declared prisoners of war. They were all shipped to a prison camp near Shanghai, where they took their luggage, including one footlocker carrying Ashurst's name that was for some reason considered by the colonel to contain the most precious of the fossils. These items were stored in a warehouse at the camp. While they were at this camp, the Japanese made another search of the baggage, apparently, in Dr. Foley's opinion, looking for *Sinanthropus* remains, But the marines had managed to conceal the box and it was not disturbed by the Japanese. They were still successful in safeguarding the box when they were moved to another camp at Chung Wan nearer to Shanghai.

Then in June, 1945, the prisoners and their effects were transferred once again. This time to Fungtai, near Peking. Again their luggage was searched, and once again the box escaped detection. But at the end of the war this box, which had survived so many moves and so many hazards, disappeared. The last that Dr. Foley saw of it was when he and Colonel Ashurst parted company, the former sent to an iron mine in northern Japan and the latter to Hokkaido. Colonel Ashurst died a few years after the end of the war.

What then actually happened to Peking man? The obvious answer is, We don't know. But the accounts of Dr. Foley and Mr. Davis have clarified the circumstances of the disappearance and have now given us a set of options for further search. The possibilities, with varying degrees of likelihood, are these. Some of the fossils might still be miraculously discovered at Camp Holcomb, where the Japanese soldiers ransacking the baggage of the marines might have opened some of the footlockers sent from Peking and discarded what could have ap-

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peared to them to be worthless unk. A more likely possibility vould be the safety of the boxes Dr. 'oley consigned to the Swiss Warehouse, the Pasteur Institute, and to his friends in Tientsin, if these estblishments and homes still exist nd have not been emptied and put o other uses by the Chinese, and heir contents irretrievably disersed. Would Chinese soldiers learing out such structures have een any more sophisticated in the cientific value of fossils than their apanese predecessors? That leaves he single box that Colonel Ashurst nd Dr. Foley had cherished for our years. If it was taken over at ong last by the Japanese when 'olonel Ashurst was transferred to lokkaido, and if it still contained ome of the fossils, the chances are ood that they would have been arefully preserved by them. It is bvious from Whitmore's discovery f Choukoutien specimens in Tokyo nd from the persistent search of)r. Foley's baggage that the Japaese were eager to lay their hands n the famous fossils.

It might, at this point, be asked vhy worry about the fate of these ossils. New ones representing the arly Peking population have been ound and others are likely to be exumed in the future. Can't these relace the lost ones? The answer is hat such a site as Choukoutien is ot inexhaustible. More fossils may vell come to light there, but it is nost unlikely that a series as large nd representative as the original ne will be available. Moreover, any ss of this kind is a tragedy and a erious deprivation to the study of he emergence of man. The publicaions on the original specimens, good s they are, may well need revision in he future as new methods and data ecome available. For this there is no ubstitute for the specimens on vhich they were based.

But when all this is said, there emains the very human reaction to baffling question. If we knew inontrovertibly that the fossils were lestroyed and are unrecoverable, ve would, I think, reconcile ourelves to the situation. But as long s there is a shred of hope, some of is will continue to do what we can o save the lost remains from slipping, through neglect, back into the nonymity from which they had nce been laboriously rescued. ■

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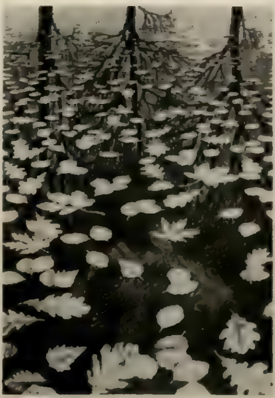

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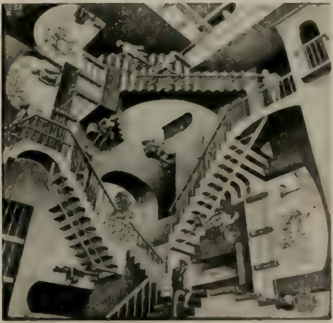

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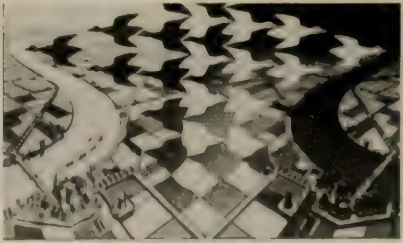

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Living on the Last Whole Earth

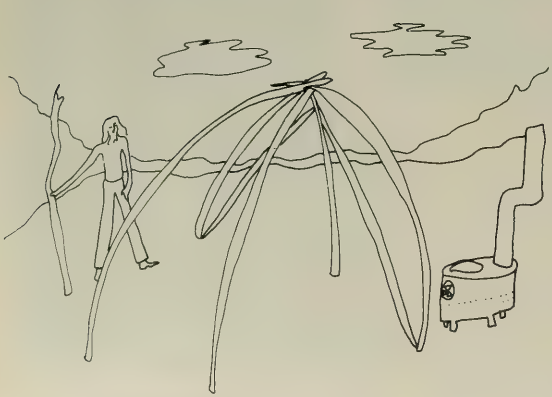
by Edward Abbey

LIVING ON THE EARTH, by Alicia Bay Laurel. *Vintage Books/Random House, $3.95; 193 pp., illus.* THE LAST WHOLE EARTH CATALOG: ACCESS TO TOOLS, edited by Stewart Brand. *Portola Institute/Random House, $5.00; 447 pp., illus.*

These are handbooks for opt-outs. If you think you are ready to withdraw from the industrial system, either *Living on the Earth* or *The Last Whole Earth Catalog* might be useful to you. The first is a direct, handy how-to-do-it book, covering everything from backpacking, through midwifery, to woodcarving; the second, a massive compendium of books and tools that. you will need out there. Out there in the country, where *the people* used to live.

Alicia Bay Laurel—the author has named herself after her favorite tree—presents us with what she rightly calls a "harvest" of good life information. The index begins with *abacus* and ends with *zither.* The philosophy interleaved among the pages begins with the sun and ends with the moon and stars. Life and earth form the middle. With every paragraph is a simple line drawing to illustrate the words. The idea underlyin the book is the one that has capture the imagination and hopes of so many particularly the young, in this age o iron, cement, and technotronic tech nique: a return—somehow—to the gree earth that twentieth-century industrialism has come close to destroying.

"This book is for people who woul rather chop wood than work behind desk so they can pay Pacific Gas & Electric." Exactly. "When we depen less on industrially produced consume goods," says Alicia Bay Laurel, "w can live in quiet places. Our bodies be-



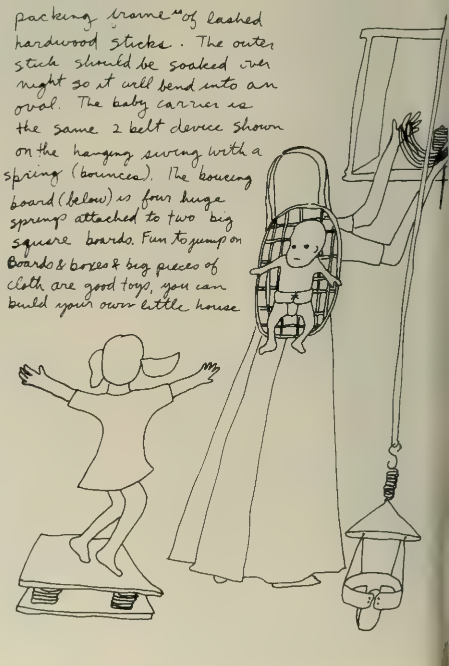
a dome for all weather

preferably where no trees can fall on it and with no slopes above it so water can't run in during rain. dig a ditch around circular cleared area if you are below a slope

frame: dig holes for the branches. lash at top. Brace against wind with diagonal branches Tie strips of cardboard on tops of branches to protect the plastic

door: face away from prevailing winds but east is best for seeing the sunrise from your bed.

walls cover frame except where door goes and leave a space at top for a skylight any cloth will do Behind the stove put a sheet of metal For cold weather add insulation (fiberglass) over the cloth Cover with clear plastic Bury edges all around dome. Caution. plastic is very flammable



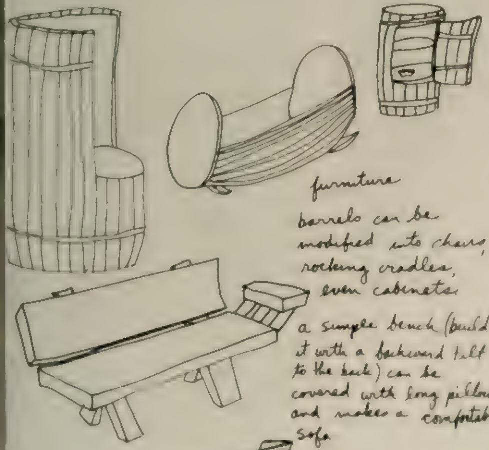
packing frame" of lashed hardwood sticks. The outer stick should be soaked over night so it will bend into an oval. The baby carrier is the same 2 belt device shown on the hanging swing with a spring (bounces). The bouncing board (below) is four huge springs attached to two big square boards. Fun to jump on Boards & boxes & big pieces of cloth are good toys, you can build your own little house ome vigorous; we discover the serenity f living with the rhythms of the earth. We cease oppressing one another." Pre-isely.

That noble old dream. And not al-ways merely a dream: see Helen and Scott Nearing, for example. And so the ook is about doing things yourself, so ar as possible. How to build a good hair. Or a houseboat, a kayak, and a ouse. How to start and keep a garden, ow to milk a goat, how to make soap, ow to sew a baby's jumpsuit from two airs of men's socks and a cardigan weater. The virtues of voluntary poverty. Back to the hills. Where we came from.

How to tie knots and fire bricks, to stuff dolls and form candles, can berries, dress a deer, build a compost heap, prune an apple tree, bake bread, brew beer, steam a fish, cure a cold, handle posion ivy, bear a baby, cure dandruff, construct a steam bath, treat crab lice (one of the likely joys of back-to-earth, down-home living), make a toothbrush from an alfalfa root, splint a broken leg, treat for heatstroke, exercise the eyes, rescue a drowning swimmer, and launch the dead:

"To die in the forest. . . . Cremate on a hot fire so the smoke goes straight to heaven and the ashes to the four winds. Then a wake, the joy of liberation. . . ."

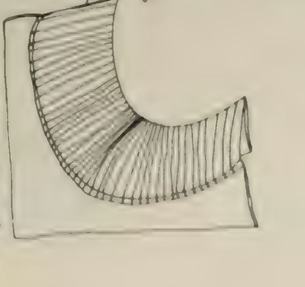
There is a pathos in all of this, despite, or maybe because of, the author's repeated invocations of joy. It's a hard thing to swim against the tide. New communes are started every week; few survive. Almost none have yet succeeded in becoming self-sufficient. Surrounded, outnumbered, and overwhelmed, those brave few who now attempt living on the earth face formi-



furniture

barrels can be modified into chairs, rocking cradles, even cabinets

a simple bench (build it with a backward tilt to the back) can be covered with long pillows and makes a comfortable sofa



girl named dana
gate 5 sausalito
gned this chair →
2 identical
wood forms
a number of little
½" boards of identical
th after nailing the
ds to the 2 forms, you
ht stain it dark
varnish it

into a clean jar put
cut up garlic and dill
weed then some
slightly under-ripe
(hard) vegetables
pickling cucumbers
green tomatoes
lemon cucumbers
onion slices
hot peppers
pimento
cauliflowerets
carrots
[illegible]
boil together water, salt
and apple cider vinegar
the proportions can vary
according to taste
pour liquid into jar
over vegetables & spices
when it is cold it is
ready to eat but letting
it soak great improves
it

when preparing [illegible]
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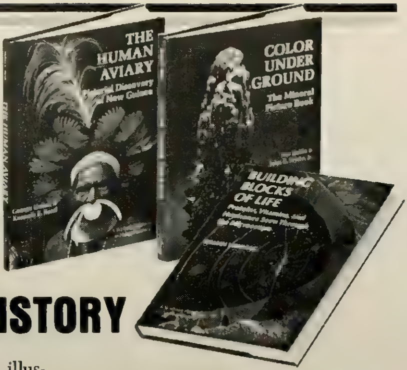

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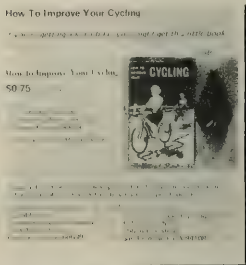
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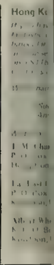
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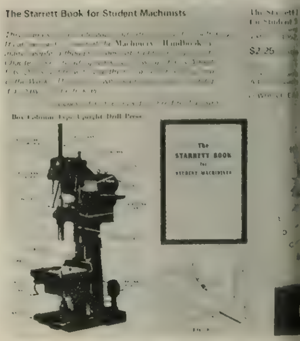
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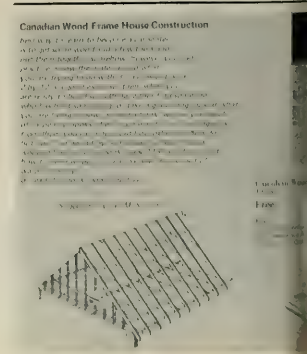
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iavior of whole systems, unpredicted by
he behavior of their respective subsys-
ems' events—all these have something
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lear. Fuller's religion of super-
echnology, repeated in book after book
n a kind of prose that resembles the
ludge you'd drain from your crankcase
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ompatible with the organic and living
cosystem of real earth. I wonder if
Stewart Brand or many of the admirers
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ur world. Do you *really* want to live in
Plexiglas city? I want to ask them. Do
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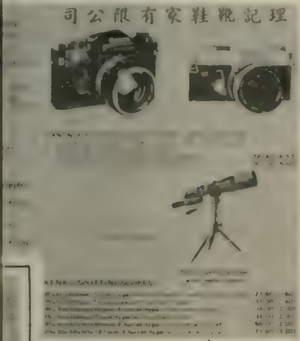

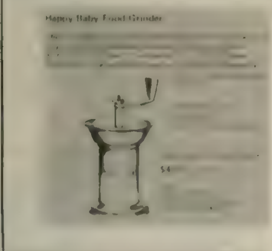

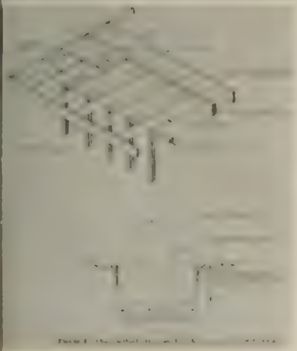

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wired into a central control center and never have a private thought again for the rest of your life? R.B. Fuller ought to get together with B.F. Skinner: they both want to put us all in a box.

This is a quibble. After the first two pages devoted to reviews of Fuller's books, the *Catalog* gets down to sanity with excerpts from Wendell Berry (*The Long-Legged House*) and a reprint of Gary Snyder's splendid tract *Four Changes.* Following the first section on books comes the real business of the *Catalog*—access to tools. More than four hundred pages of it. So you want to start a farm, a commune and community, a printing shop, a credit union, or a community market? The *Catalog* tells you where to send for the right equipment, what books to buy for procedural know-how.

The *Catalog* is selective, not an encyclopedia. The editors define its function as follows:

> "An item is listed in the *Catalog* if it is deemed:
>
> 1) Useful as a tool
>
> 2) Relevant to independent education
>
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The purpose of the *Catalog* is defined in this way:

"We are as gods and might as well get good at it. So far, remotely done power and glory—as via government, big business, formal education, church—has succeeded to a point where gross defects obscure actual gains. In response to this dilemma and to these gains a realm of intimate, personal power is developing—power of the individual to conduct his own education, find his own inspiration, shape his own environment, and share his adventure with whoever is interested. Tools that aid this process are sought and promoted by the *Whole Earth Catalog.*"

Alicia Bay Laurel's little book tells you how to do certain basic back-to-earth things, like feeding chickens and canning tomatoes. *The Last Whole Earth Catalog* is immensely more comprehensive but not so direct, telling you what the books and other tools are (good books are, of course, also good tools) that will show you how to do things, understand things, love things. I recommend both. They're cheap at the price and may someday save your life.

Author and former park ranger Edward Abbey now spends a good part of the year as fire lookout at North Rim, Grand Canyon.

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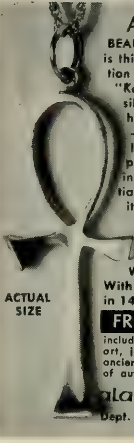
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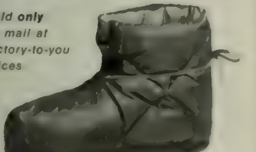

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More Reviews

HORSES IN AMERICA, by Francis Haines. *Thomas Y. Crowell Co., $7.95; 213 pp., illus*

The most fascinating chapter in the history of the horse in America is the one only the paleontologists could tell, and they have no records of it. That, of course, is the account of what happened to the pony-sized *Merychippus* that evolved from the hare-sized *Eohippus* in the five million years or so before *Equus caballus*, the true horse, appeared in Asia. The primitive horse simply vanished from America, and the true horse returned over the land bridge between Siberia and Alaska about 600,000 B.C., only to vanish again about 9,000 years ago. And then, about 400 years ago, the horse came back once more, this time brought by the early Spanish explorers.

Francis Haines tells the story, covering those misty beginnings in less than one chapter, then going on to relatively modern times. Along the way is the background of the horse in Asia, the nomad tribes that domesticated the animal, the far-wandering horsemen who were a scourge throughout the Near East and then well into Europe. There is the account of how the horse became the dominant force in European wars, how the armored knights needed big horses simply to carry them, and how eventually those big horses became western Europe's draft animals. And there is the story of the Spanish horses, smaller, tougher, faster animals, and how they were brought first to the West Indies, how the island horse ranches throve, how their horses became the mounts for so many of the Spanish goings to and fro in the American Southwest. And how, out of this, came Spanish horse herds here, Indian horse thieves, and the whole history of the mounted Indians of the West.

Haines tells his story well, with the

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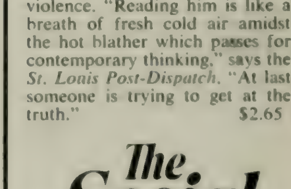
Robert Ardrey



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emphasis on the Southwest and West, where the horse and horsemen dominated history. At times he seems to overstate the use of the horse by the early Spanish explorers—those early Spaniards did a lot of foot slogging, in part because the Indians found that horsemeat was good to eat. Later the Indians learned to ride and stole a great many Spanish horses, both from the expeditions and the early Spanish ranches. Haines mentions this and brings the story down through the big-ranch days, the cowboys, and the horse culture of the West. This, with the Spanish beginnings, forms the bulk of the book, and the proportion seems right.

Elsewhere he gives due attention to the eastern horses and their origin, to the reason horses displaced oxen on the farms, to saddle horses in the east, to race horses and show horses. The horse took over on the farm because the evolving farm machinery wouldn't work properly when drawn by plodding oxen. Horses were needed to pull a mowing machine or a binder fast enough to make it work right.

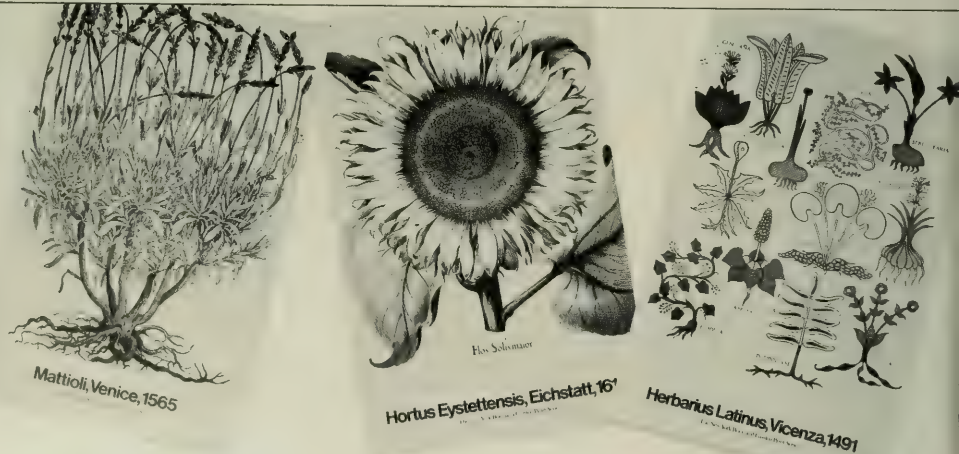
Haines also covers the whole matter of the mounted soldier in America, from the Plains Indian, who was one of the best cavalrymen the world ever knew, right through the cavalrymen who fought him, through the Civil War and the cavalrymen in that conflict. That, he points out, was the last war in which horse cavalry was an important element. After the Civil War came the big western ranches, and by the end of the nineteenth century the settler with his plow began to close off the open range. Then came the automobile, the truck, the tractor—and the horse became a luxury. Now the horse population is slowly increasing again. But the horse is essentially a part of history. And this book is an excellent summary of that history.

HAL BORLAND

THE LIVING CLOCKS, by Ritchie Ward. *Alfred A. Knopf, $8.95; 416 pp., illus.*

This book has a central, unifying theme, the description of biological rhythms and their control by living clocks. However, the emphasis is truly on people and their approach to a problem, and the work would be more accurately entitled, *The Stories, Liv and Thoughts of the People behi Biorhythms.* In his selection of pers ages, the author has picked some w are colorful, some dull; some who ha made profound, and others who ha made trifling, contributions; some mous, some unknown; and the net r sult of this uneven presentation is a v illation of fascination in context. T book appears to be patterned after Pa de Kruif's *Microbe Hunters* but, sin the characters of *Living Clocks* are n working on problems anywhere directly relevant to man's well-being, does not have the impact of the form I am afraid that a stranger to the fie may find parts of the bibliographic a pects of the book tantamount to readi about the personal lives of the PTA in remote town.

Ritchie Ward's formal training co sisted of a unique combination of chem istry and journalism that culminated his becoming a technical writer speci izing in biographical sketches. As a sc ence writer he must rely heavily on a peal to authority and the account monotonously rife with paragraphs b ginning: "As Isaac Asimov has. . . "Janet Harker . . . first showed. . . .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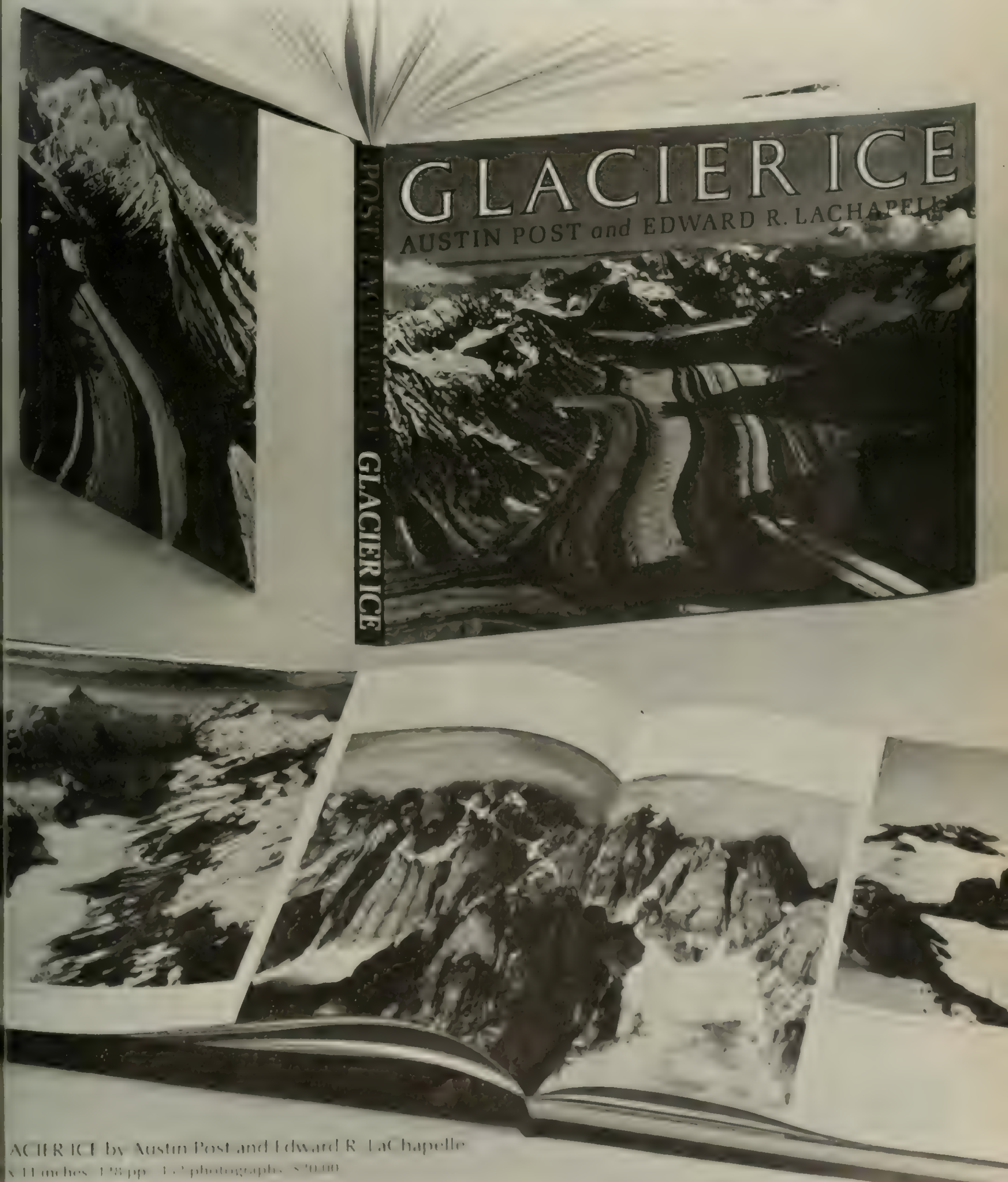

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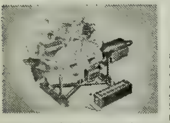

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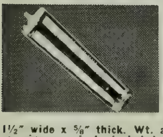

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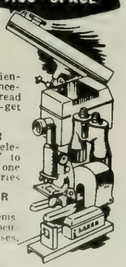

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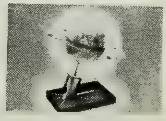

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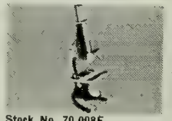

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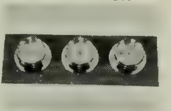

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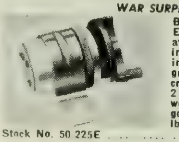

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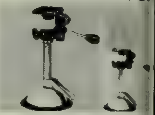

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ABOUT THE AUTHOR: Preceding his graduation from Concordia Seminary, St. Louis, Mo., Harold Roellig published "Reasoned Unbelief, circa 1957"—an article cast as a Socratic monologue that trenchantly defined from an agnostic point of view the issues and tensions between the contemporary scientific world view and the Judaeo-Christian tradition. This article was the culmination of years of undergraduate and graduate study in the social and natural sciences taken at Washington University concomitantly with the author's seminary training.

The issues explored in this article led Mr. Roellig, in 1957, to graduate work in the Geology Department of Columbia University in order to study with Dr. George Gaylord Simpson and Dr. Theodosius Dobzhansky. After teaching invertebrate paleontology at Columbia and sociology at Concordia College during sabbaticals, he began, in 1960, his doctoral dissertation on fossil vertebrate specimens at the American Museum of Natural History; that same year, he was appointed Lutheran campus chaplain for Long Island colleges.

In 1964 the author was appointed part-time instructor in geology at Adelphi University; in 1967 he received his Ph.D. from Columbia's Department of Geology; in 1969 he resigned his chaplaincy and accepted an appointment as assistant professor at Adelphi.

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and two favorable assets. First, is t
author's lack of self-discipline in kee
ing to the subject. The text often
verges tortuously away from the centr
theme, rambling through such unrelat
topics as Einstein and relativity, t
voyage of the *Beagle*, Fermi, chain r
actions, and squash courts; and so
through twenty-two chapters. The se
ond weakness is that the author quot
many of his experts' writings verbati
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chapter with their words. Were it n
for the colorful descriptions of the pa
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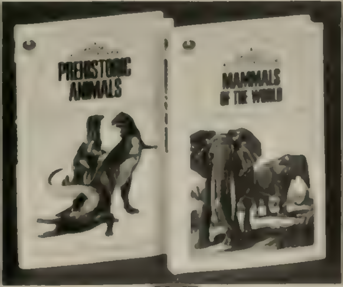

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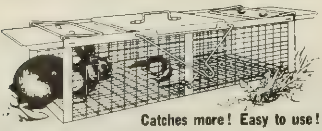

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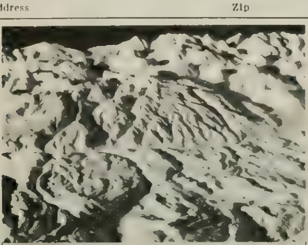

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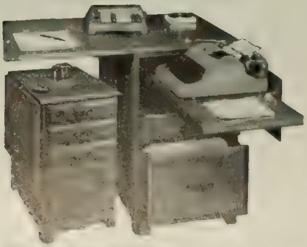

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The Fossil Evidence for Human Evolution. W. E. Clark. University of Chicago Press, Chicago, 1964.

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THE EARLY WARNING OF THE TERNS

Pollutant Concentrations in Abnormal Young Terns from Long Island Sound. H. Hays and R. Risebrough. *The Auk*, in press.

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Central American Sea-Level Canal. I. Rubinoff. *Science*, August, 1968.

Poisonous and Venomous Marine Animals of the World. B. W. Halstead. U.S. Government Printing Office, Washington, 1965.

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Armenia: Travels and Studies. Vol. 1. H. F. B. Lynch. Longmans, Green, & Co., London, 1901.

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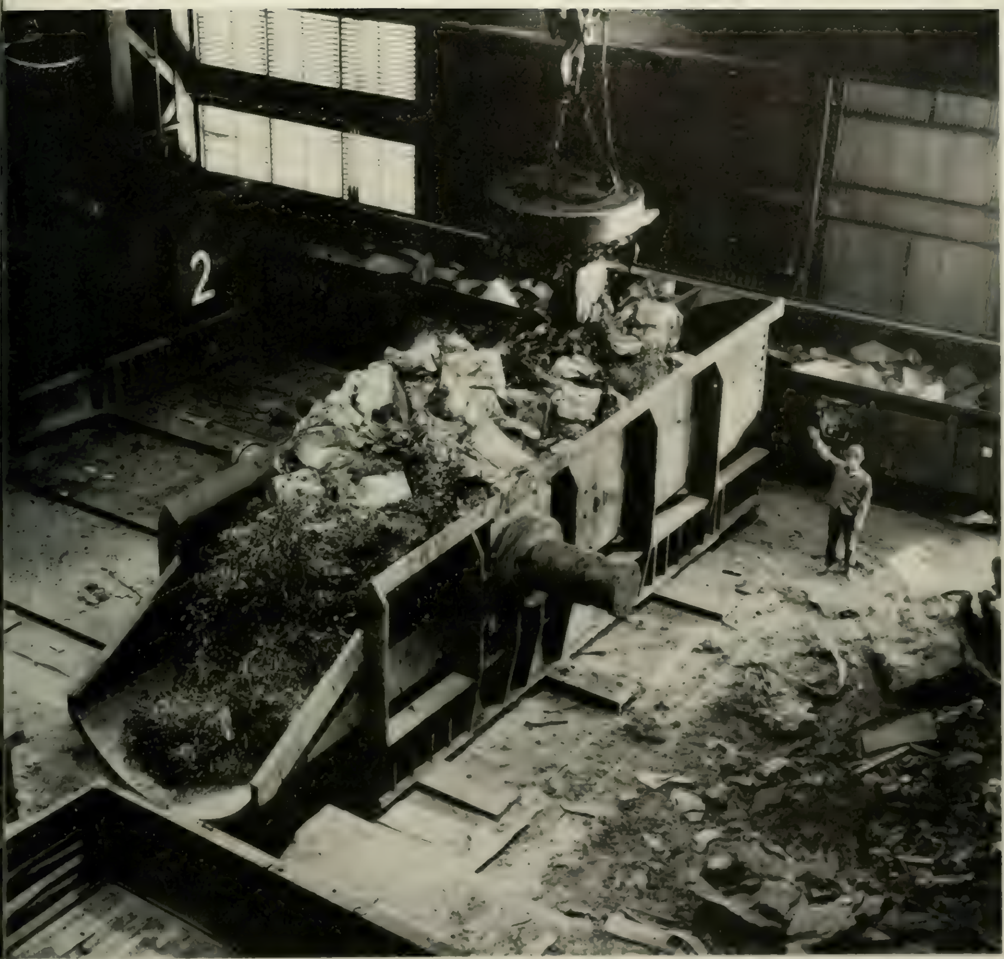

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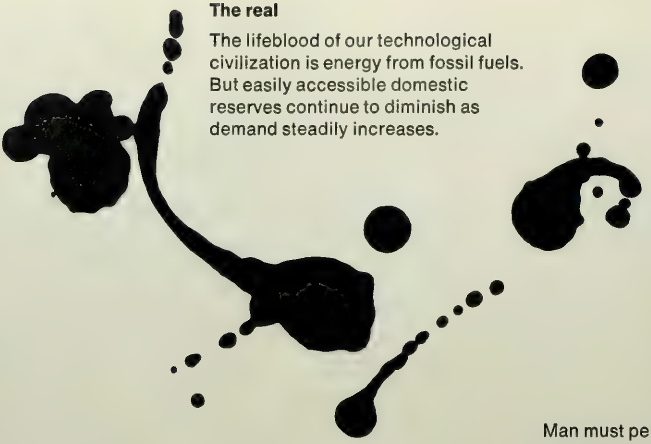

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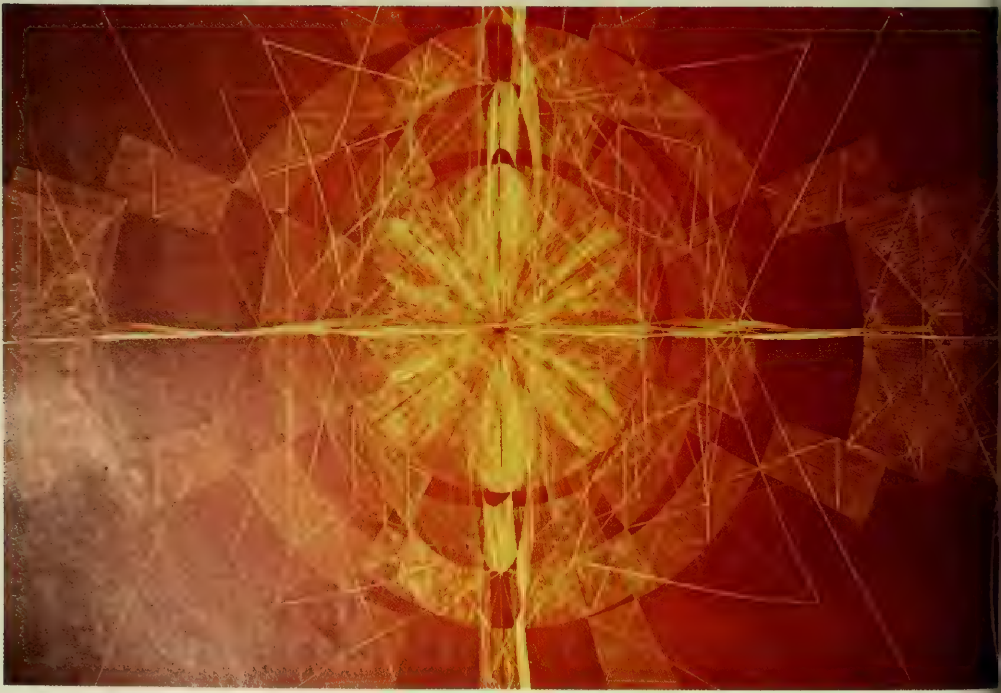

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NATURAL HISTORY

INCORPORATING NATURE MAGAZINE

The Journal of The American Museum of Natural History

Gardner D. Stout, President   *Thomas D. Nicholson, Director*

Vol. LXXX, No. 10   December 1971

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Authors

Because the compulsions and frustrations of bird watchers have long interested **Donald Zochert**, writer for *The Chicago Daily News*, he was able to recognize the problems Thoreau faced in identifying a common species of sparrow. Thoreau, unable to classify the bird, called it the "seringo." Zochert, who has a B.A. in English from Elmhurst College, finds "a kind of balm for the amateur ornithologist in the failure of this most observant of men to positively identify his prey." A case study of the content and ideology of popular science in a pioneer village and a biography of James Clyman, American frontiersman, are Zochert's current projects.

Cryobiologist **J. K. Sherman** has studied the many effects of cooling, freezing, and rewarming on the protoplasm of various cells and tissues, as well as the low-temperature preservation of living cells, especially mammalian gametes. Sherman, a professor of anatomy at the University of Arkansas School of Medicine, has a Ph.D. in zoology from the University of Iowa.

Very few "outsiders" can speak Shelta, the language of the Irish tinkers. **Bryan MacMahon**, whose concern with these nomadic tradesmen is a natural adjunct to his key role in the revival of interest in Irish arts and traditions, learned the language by living with tinkers in their roadside encampments. By turns a folklorist, poet, playwright, novelist, lecturer, and ballad maker, MacMahon received early recognition as a leading figure in Irish literature. He is now principal teacher at Scoil Realta Na Maidine 2 (Morning Star No. 2 School) in Listowel, County Kerry.

The photographs of the Irish tinkers are the work of **Mathias Oppersdorff**, a photographer whose assignments have taken him to Mexico, Europe, and India. He is currently on his third trip to Arabia, where he hopes to "record on film the rapidly disappearing romance of the old Arab life-style before it becomes completely Coca-Colaized." Oppersdorff, who has a M.A. in international relations from

American University in Washi
ton, D.C., previously photograpl
"Death in Chamula" for NATU
HISTORY MAGAZINE, January, 19

Warren Zeiller was first
tracted by the lovely nudibran
while he was doing the resea
for a book covering a broad ra
of invertebrates. Curator of
Miami Seaquarium, he has m

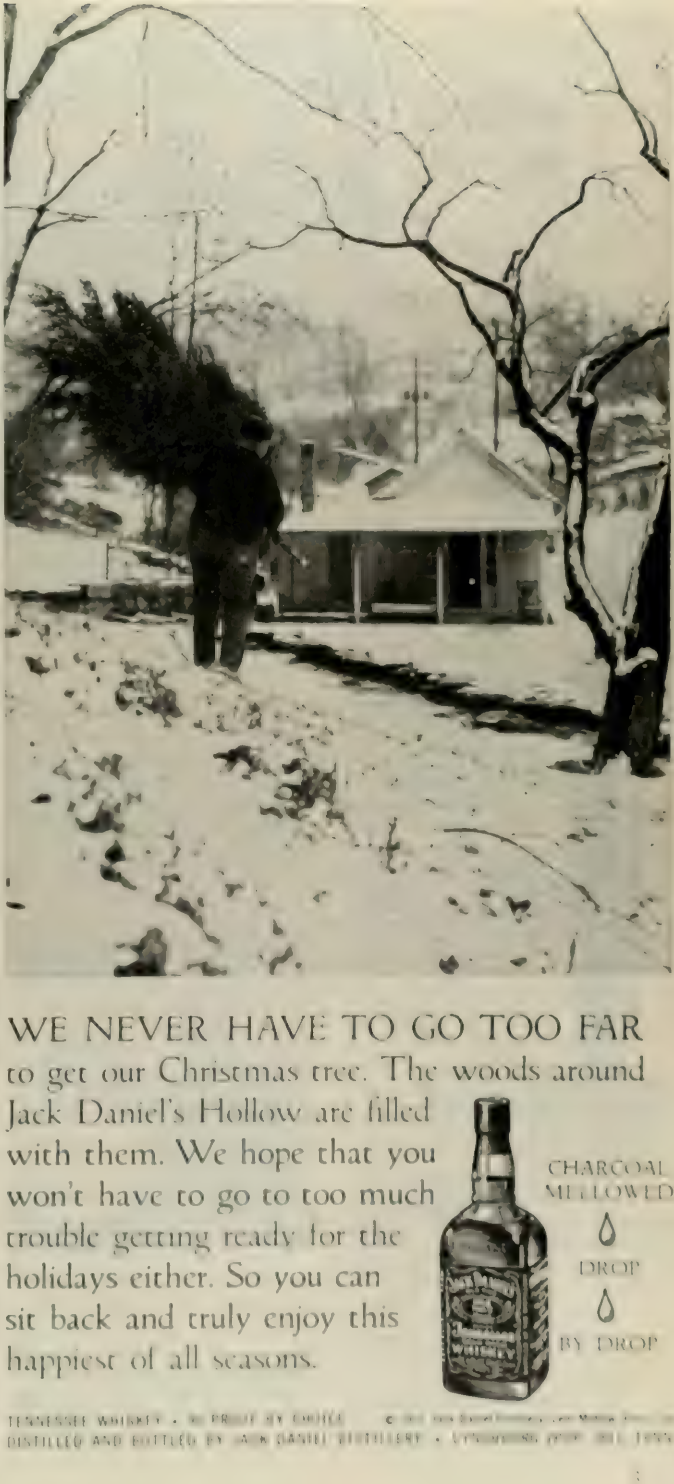
careful observations of the hatchi
process of nudibranchs in an op
system aquarium. This, togeth
with other studies, has provid
him with an insight into the life
these shell-less mollusks. Zeill
earned a B.S. in animal husband

om Colorado State University and continuing his experimental work the maintenance of marine in- rtebrates in aquariums.

Coauthor of "Fly in the Sun- w," **Terry Ashley** investigated e digestive processes of car- vorous plants while working with seph F. Gennaro. As a result of at experience, she found her he in cytology—particularly in e study of the correlation between ucture and function in different ganisms. She is now on a post- ctoral fellowship at the Univer- y of Lethbridge, Alberta, Canada, here she is studying the end-to- d associations of chromosomes d their kinetochore orientation.

shley is also researching the uses of early postfertilization fail- res in interspecific plant hybrids. he received a Ph.D. in genetics om Florida State University.

Joseph F. Gennaro, Jr., has een experimenting with new re- arch techniques involving the anning electron microscope. The ree-dimensional representations rovided by this instrument have iven researchers a major new tool or the investigation of lower orga- isms. The photographs of sundew lants, taken by **Barbara Panessa** —one of his students, who has an biding passion for carnivorous lants—represent another aspect of



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Authors *Continued*

these experiments. Gennaro, professor of biology at New York University, takes to his life raft when eyestrain causes a headache. The dog makes sure that Gennaro goes in the right direction.

Robert van den Bosch's advocacy of the biological control of insects can be traced back to 1947, when he began his career as Supervising Entomologist of the Westside Alfalfa Pest Control Association, Dos Palos, California. Since then, he has become increasingly disturbed by the continued misuse of

pesticides in insect control programs. His research interests in integrated pest control, the ecology and biology of parasitic and predacious insects, and the biosystematics of aphids have led to field work in Europe, North and East Africa, the Near East, Pakistan, and Japan. Van den Bosch is chairm of the Division of Biological S ences and professor of entomolo at the University of California Berkeley, where he obtained h Ph.D. in entomology.

His interest in how nervous systems control behavior, and the relation of laboratory studies in neurophysiology to the behavior o animals in their natural environments, led **Edward S. Hodgson** t his present study of sharks. Hodgson is chairman of the biology department at Tufts University and research associate at The America Museum's Lerner Marine Laboratory in Bimini. Here he anesthetize a lemon shark preparatory to operating on its nose and removing th organs that control taste and smell.

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Letters

Which Way Will You Be Lead?

What is a reader to believe?

I received in today's mail a clipping from the September 19 *Morristown* (Tennessee) *Citizen Tribune* and have just finished reading:

> The current move toward unleaded gasoline for cars is the kind of misleading and irrelevant course of action that makes a solution to air pollution seem impossible. First of all, there is no evidence that lead in the atmosphere, from automobiles or any other source, poses a health hazard. Spokesmen for the U.S. Surgeon General, the American Medical Association, the U.S. Public Health Service, and the World Health Organization have all said that lead in the atmosphere is not now nor foreseen to be a threat to health.

Then the October, 1971, issue of NATURAL HISTORY MAGAZINE arrived. And in the article "Greetings from Los Angeles," by Ira J. Winn, I read:

> Lead is also a deadly poison. . . . Its effects are cumulative and result in a large number of health problems, beginning with such symptoms as fatigue, dizziness, cramps, and headaches, and eventually leading to a variety of disorders that can end in paralysis, brain damage, and death. A number of scientists suspect low-level lead poisoning as a cause of many of our ills.

Confusing, at least, wouldn't you say?

JAMES L. BAILEY
Director, Educational Service
Tennessee Department of Conservation

Editor's Note:

Mr. Bailey's letter raises some interesting questions. To satisfy our curiosity, we tracked down the story that appeared in the Morristown newspaper. We found it had come from *Editor's Digest* in New York, a division of Planned Communication Services, Inc., a company that writes and distributes stories to small-circulation newspapers on behalf of corporate and industrial clients. This story, it turns out, originated with the Lead Industries Association (LIA) in New York. LIA's public relations firm, Hill & Knowlton, funneled the information for the story to *Editor's Digest*. We note in passing that readers of the Morristown paper had no way of knowing that a story about lead in air pollution originated with the Lead Industries Association.

The Author Replies:

The campaign against environmentalism is now moving into high gear and readers should be advised to expect an outpouring of half-truths, invective, obfuscation, and plain old lies as the polluters go all out to convince the people that all is well with things just as they are; that anyone who criticizes the system is a disaster-monger; and that industry is prepared to lead the way in the antipollution struggle and doesn't need any advice from onlookers or any regulation from the federal government.

But the carefully planted and phony stories aimed at lulling growing public fear of airborne lead poisoning from automobile exhaust are a superb example of just why the general public and the scientific community should have a deciding voice in matters of environmental concern and why federal control over air polluters is essential if we are to avoid a public health disaster.

These planted fables show how the polluters' campaign gears up when the economic chips are down. Let's look at how the deck is really stacked, as seen by some genuine experts.

Dr. Henry A. Schroder of the Trace Elements Laboratory of Dartmouth College, one of the world's foremost authorities on the effects of metals on the human body, states flatly:

> Airborne lead is largely a result of anti-knock additives to gasoline in the form of tetraethyl or tetramethyl lead. . . . Lead offers a potential and imminent hazard to human health. . . . We have found enough lead in vegetation growing beside a secondary highway (up to 200 parts per million) to abort a cow subsisting on this vegetation. The concentration has trebled in six years. . . . Evidence of a biochemical abnormality in persons exposed to urban air concentrations of lead is beginning to appear. There is little doubt that the present rate of pollution, disea due to lead toxicity will eme within a few years.

R. A. Kehoe, a specialist in l toxicology, reports that 30 to 40 p cent of lead inhaled by humans is sorbed into the body, while only 5 p cent of the lead intake from water a food is absorbed.

Dr. John R. Goldsmith, head of e demiology for the California Depa ment of Public Health, finds that blood lead levels in persons living n a freeway are markedly higher than persons living in relatively clean coas air a mile from that freeway.

Tsaihwa J. Chow, a specialist on le at the Scripps Institution of Ocea ography, reports that concentrations lead in plants growing near highwa are many times higher than what found away from traffic. Dr. Chow, internationally acknowledged expert lead and a consultant to the Natio Research Council, has taken stro public exception to a news release sued by the Council about its 500-pa lead study published last summe Chow, who had worked on the stud charged that the release distorted th essence of the report and gave "a fal sense of security and well-being." D Chow made clear that airborne le threatens health in most urban area including virtually the entire Los A geles basin, and the hazard is not li ited to central cities. No other tox chemical pollutant has accumulated man to the extent of lead, which pos "an identifiable, current threat to th general population," he said.

Airborne lead in the cities studie Chow concludes, has been increasi about 5 percent per year or 55.7 pe cent for Los Angeles in the 196 alone.

Peculiarly, the NRC press release i dicated that "some" cities studie showed increases, whereas the report i self states that 17 out of the 19 sit studied showed large increases in ai borne lead. The news release stated tha the average American ingests more lea than he inhales, a statement sure t mislead the public simply because mo lead taken in through the mouth is e creted, while that taken into the lung etained to a much higher degree.

The release argued that two to three es as much lead is added to the envi- ment in the form of paint pigments l metal products as in the form of oline additives, a fact of dubious ue considering that relatively few ple munch on paint or eat car bat- es. And to top off the simplistic non- se that was handed out to the press l widely circulated, the NRC re- se in part written by a former em- yee of one of the world's leading pro- ers of lead additives for gasoline— ed that "only young children and tain groups of workers face potential lth hazards from airborne lead." rhaps to the polluters and profiteers, 'y is a nice clean adjective to place front of lead-poisoned children.

In sum, I can only remind the read- public that the price of clean air, the price of liberty, is eternal vigil- e. The foxes are still trying to guard henhouse, and if you don't believe go outside one stinking day in Los geles, take a deep breath, and re- mber what Admiral Rickover ob- ved: "You don't have to be a hen to ell a rotten egg."

Ira J. Winn

e Kind to Your Links in the Marsh

I read "Creature from the Marsh" h some interest and rather more usement, because one of the Army nts that recurs to memory when I ve been standing too long in the sun titions: "Be kind to your friends in swamp, for a duck may be some- dy's mother."

Personally I could be more easily em- rrassed by my descendants than by ancestors. Also as a farmer and a ecological pragmatist, I have a great spect for existing animals. I figure se creatures had what it took or they ould not have reached the here and w.

My admiration extends backward rough all the hypothetical "missing ks" to our plain old contemporary llfrog, who wears his brain all over s nervous system, never has a head- he, toothache, allergies, or psy- ological hang-ups. The one that lived our springhouse for twenty years, I lled "Grandpop." He knew more about me than I knew about him and I respected him for it.

I do not respect the recent gener- ation of biologists who learned about animals from rats in research cages and seem strangely deficient in horse sense, a colloquial term that means more to a horseman than my dictionary admits. To us oldsters, the term implies a dan- gerously canny use of one's quick and sensitive perception.

A hundred and fifty sheep, four equines, four bovines, two canines, and a multiplication of felines grace our hill. In each genus certain individuals have made fuller use of their potentialities than others. In this regard, I am prob- ably the worse failure.

J. O. Harvey
Glade Spring, Virginia

Her Men Rupture Easily . . .

In the article "Creature from the Marsh," Loren Eiseley writes: "As for man, he is no different from the rest. His back aches, he ruptures easily, his women have difficulties in childbirth, all because he has struggled up upon his hind legs without having achieved a perfect adjustment to his new posture." This statement implies that women, who make up more than half the human race, are not typical members of the species, to be included in any accurate description of the whole, but secondary forms, defined only in relation to the male minority. In Eiseley's terms, men do not simply belong to the species *Homo sapiens;* they constitute that spe- cies and their gender exemplifies its norms. This isn't science –it's sexism.

In illustration of this point, try the passage the other way around: "As for the human being, she is no different from the rest. Her back aches, she has difficulties in childbirth, her men rup- ture easily. . . ."

Alma E. Graham
New York, New York

Society for the Protection of Tiger and Fox

After reading "I Went to the Animal Fair . . . the Tiger and Fox were there," I felt that Judith Shapiro certainly wasn't in agreement with theories presented in *The Imperial Animal* concerning man's relationship to other animals, but I couldn't figure out exactly why. Then I realized that the reviewer seemed to believe that she, as a woman, was the object of an attempt by the authors to somehow demote her fair sex. Time after time she demonstrates her ability to use sentences "deceptively connected by a 'thus' or a 'therefore' in the absence of empirical justification and sometimes with a total disregard for elementary logic" in supporting her claim.

I would like to list three points on which I disagree with the reviewer:

1. Just because male and female offspring come from the same parents doesn't mean they will inherit the same abilities.

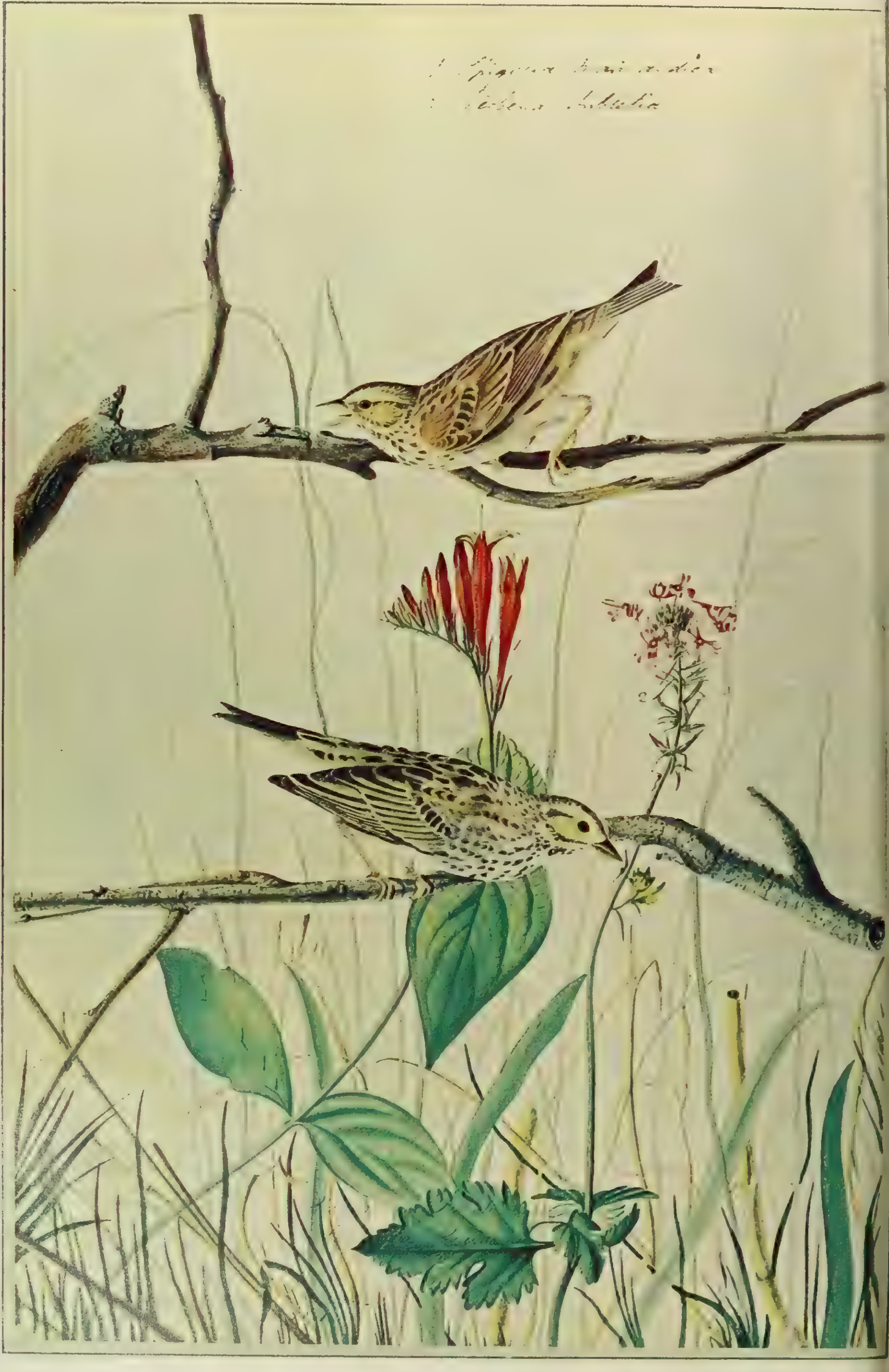
2. There are many ways to realize truth; and intuition, instinctive knowledge, when it is allowed to surface through the confusion of conscious thought, is most reliable. Not everyone must take "the arduous paths followed by political theorists and moral philosophers." Rules should be a companion, rather than a guide.

3. A person who refuses to give up an old idea when a new and more believable idea is presented is a person who slows the changes that must occur with the continuing evolution of man. I consider the fact that Professor Tiger changed his attitude toward "those who seek to exploit the obvious interest of this topic by offering intellectual shortcuts to solutions" is a bold display of belief in his new theories. May others soon follow.

Rich Fuller
Wellfleet, Massachusetts

Judith Shapiro's critical review of the popular literature on the animal origins of human behavior contains some excellent points, but tends to perpetuate some misconceptions. Differences between cultures are often taken to mean something about the power of learning and the lack of genetic influence. If I am not mistaken, unless there were genetic [illegible] between two cultures, differences between these cultures are not signs of the possibility of genetic variation.

Gary L. [illegible]
Assistant Professor of Psychology
University of Utah


1. Spigelia marilandica

2. [illegible] [illegible]

The Elusive Seringo

by Donald Zochert

What is that sound that haunts me so?

The yellow frame house at 73 lain Street. Concord, caught the iorning sun high on its roof. It was ve o'clock, the first day of May, 852. A door opened, and Henry)avid Thoreau stepped out into the oadway. The sky was clear, the air nging, the fields white with frost.

Thoreau sauntered down the treet toward the railroad depot. 'rom the great, shivering oak beind the station came the swift and :y jingle of a chipping sparrow, onoring a new day. For a moment 'horeau stopped and listened, then egan his long, familiar walk to his cliffs" in the woods to the south.

It was on this walk that his ear aught another song, stranger than he first—an earth sound he called t—fine and metallic. It was to aunt him for the remainder of his lays. This is the story of the strange nd mysterious seringo, Thoreau's fforts to identify it, and the hanges that it rang in the most obervant of men.

There seemed, at first, to be little loubt about the seringo:

"I hear the note of the shy Savannah sparrow, that plump bird with a dark-streaked breast that uns and hides in the grass," Thoreau wrote in his journal. "I iear it now from deep in the sod—or there is hardly grass yet. The oird keeps so low you do not see it. You do not suspect how many there re till at length their heads appear. The word *seringo* reminds me of its iote—as if it were produced by ome kind of fine metallic spring. It s an earth-sound."

The next day, however, he was ess certain: "I think that my eringo-bird has not the marks of the Savannah sparrow," he puzzled. "Looks like a chip-bird, or did I see a spot on its breast?" Later, when he heard the seringo sing from an apple tree, he felt sure "it must be one of the species of song sparrow."

Only one thing was clear—the song of the seringo seemed distinctive enough to identify easily by ear. The very afternoon that Thoreau heard it singing from the apple tree, he also heard its note sounding from the railroad, "like the dropping of a file, or any bit of steel, on an anvil."

Not until two weeks after he first recorded the seringo in his journal did he get a good look at the bird itself. "My seringo-bird is reddish-brown," he observed, "with a spot on the breast and other marks, two whitish lines on back, and some white in tail; runs in the grass, so that you see nothing of it [even?] where the grass is very low; and sings standing on a tuft of grass and holding its head up the while."

These welcome details served only to confuse the issue, for the appearance of the seringo seemed to fit the song sparrow, or perhaps any sparrow with dark lines converging on the breast, while its behavior seemed to describe the grasshopper sparrow more than the savanna. Furthermore, when Thoreau had the opportunity later in the month to consult Audubon's *Birds of America* in the State House at Boston, he came away convinced, for the moment, of one thing: "The seringo-bird cannot be the Savannah sparrow." He gave no reason for his conclusion.

Thoreau's journal for 1852 contains only one more reference to the seringo; he heard it singing from a post at noon and observed a light streak over its eye. Two years passed before the seringo winged back into the journal, as mysterious as before.

"Heard the bay-winged sparrow in the redeemed meadows," Thoreau noted in April of 1854, and then went back to cross out the words *bay-wing*. In their place he wrote in pencil, "One of the seringos." That change was almost certainly made after he observed the seringo again six weeks later.

"The bay-wing sparrow apparently is not my seringo, after all," he wrote. "What is the seringo? I see some with clear, dirty-yellow breasts, but others, as to-day, with white breasts, dark-streaked. Both have the yellow over eye and the white line on crown, and agree in size, but I have seen only one with distinct yellow on wings. Both the last, *i.e.* except only the bay-wing, utter the seringo-note. Are they both yellow-winged sparrows? or is the white-breasted with streaks the Savannah sparrow?"

What is the seringo? Another year went by without an answer to the question. Then, again in April, he heard the first seringo of the season and resumed the quest. "The duskyish crown is divided by a lighter line," Thoreau reported. "Above it is ashy brown and drab, a streak of lemon yellow over the eye; some brownish drab or bay making a spot on wings, white lines diverging from throat, reddish legs against sun; breast and sides dashed. It has not the note of Nuttall's Savannah, nor, methinks, the

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blackness of Wilson's. Is it the *passerina*, which Nuttall does not describe?" (In a note to this question, Thoreau answers with an emphatic "Yes," adding that Nuttall calls the bird *F. savanarum.* But he remained unconvinced.)

For all the detail Thoreau had assembled in three years, he was no closer to an identification of the elusive seringo. He seemed, indeed, to have wandered into a forest he could not see for the trees. Yet in the fall, lounging on the bank of a brook and watching "a flock of *seringos*, perhaps Savannah sparrows" flitting about the alders and dogwood, he felt compelled once again to add to his growing hoard of particulars.

"At last I saw one resting a moment to prune himself, and in this operation he opened his plumage very thoroughly to me. Distinct yellow eyebrows, extending round beneath the bill; tail blackish or dusky; primaries bay or chestnut; secondaries edged with white; some white lines on shoulders; *pale* flesh-colored bill and legs; toward vent beneath, pure white."

"The air is full of birds," Thoreau wrote the following spring, "and as I go down the causeway, I distinguish the seringo note." It was an annual call to mystery, this spring singing of the seringo. Now he tried to catch the seringo by its song. "The seringo also sits on a post, with a very distinct yellow line over the eye, and the *rhythm* of its strain is *ker chick/ker che/ker-char r-r-r-r/chick*, the last two bars being the part chiefly heard." But this brought him no real solution.

Then, late in May he stumbled upon a clue he had not considered before—he located a "seringo or yellow-browed sparrow's nest" containing four eggs. "The nest of coarse stubble, lined with fine grass, and is two thirds at least covered by a jutting sod. Egg, bluish-white ground, thickly blotched with brown, yet most like a small ground-bird's egg, rather broad at one end, pretty fresh."

When he examined the plates of Audubon and Wilson, Thoreau discovered that the eggs of the savanna sparrow "are of a pale bluish color, softly mottled with purplish brown." The conclusion seemed clear to him. As he noted in his journal, the egg of the savanna sparrow "is apparently my seringo's eg

Two summers passed before found a similar nest—"small a deep and low in the grass of t pasture"—but the eggs proved to different from those of the serin There the quest rested until t spring of 1859, when Thore turned briefly once again to his ringo. Walking along Swampsc Beach near Lynn, Massachuset he noted that he could "hear a see the seringo in fields next t shore."

These birds, he remarked, h "no noticeable yellow should pure whitish beneath, dashed thro and a dark-brown line of dash along the sides of the body." Wh he returned to Concord, he fou the seringo of his home fields "a parently or perhaps a little small and less distinctly whitish benea and with a less distinct dark line c the sides, but breast equally dashe with brown. Did not see the yello shoulder, and the head was a littl less yellow. Also note of ours a parently more feeble, first part lik a watch-spring, last more ringin and clear in both birds."

Thus ended his single brief a tempt at comparative field identi fication—as well as his search fo the true sparrow he called seringo Perhaps he finally realized the diffi culties of positively identifying th seringo, the possible confusion o subspecies, the thicket posed b changes in plumage. Bradford Tor rey, who annotated Thoreau's jour nals when they were finally pub lished, concluded that in most case the seringo was probably the sav anna sparrow, "but it may some times have been the yellow-winged or grasshopper, sparrow, or even, a Thoreau once suspected, the gras finch, or vesper sparrow. It is quit likely that at times the bird he sa was not the bird he heard."

Perhaps, too, it was just as wel that the seringo remained elusiv and unidentified, ringing its eart sound in the mind and memory o Henry David Thoreau. For hi health was beginning to fail.

Nine years and four days after h began his search for the seringo and a year before his death in May 1862, Thoreau sat at his table i Concord and wrote a single line i his journal. It said simply: "Hea the seringo note."

It was the last time.

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Immortality and the Freezing of Human Bodies

The bodies of thirteen people have been frozen in liquid nitrogen in the hope that someday they can be revived. Here are the arguments of the proponents, who say they have nothing to lose, and of the critics, who call freezing humans now hopelessly premature

The case for....

by John P. Wiley, Jr.

Hundreds of people who refuse o accept death as final are making rovisions to have their bodies kept rozen for as long as it takes science o learn to bring them back to life. They believe it is possible that in his way they will cheat death and chieve immortality.

At this time, the bodies of thirteen people are being maintained at -320° F. in tanks of liquid nitrogen. All thirteen believed that someday one of two things would happen:

1. A way would be found to actually bring the body back to life nd cure the disease that killed it in the first place.

2. A way would be found to grow an identical body from the genetic information in a cell nucleus of the original body. The genetic information for the entire organism is contained in each cell of the body; indeed, whole toads have been successfully reproduced from a single intestinal cell. This approach assumes that by the time such a technique is developed, the physical basis for memory, personality, and so on will be well enough understood so that the person's identity can be implanted in the brain of the new body.

In Farmingdale, New York, two human bodies are frozen in liquid nitrogen inside this tank. On the right side of the platform is the top of the tank, removed for inspection of the bodies.

The storage of dead human bodies by freezing is known as cryonics, from the Greek *kryo* meaning "icy cold." The people involved feel that no matter how great the odds are against success, there is at least some possibility that their dream will come true. If they allow their bodies to be buried or cremated, then, in fact, there will be no chance whatever for revival and immortality.

The decision is not taken lightly. Simply to belong to the Cryonics Society of New York, for example, costs \$30 a year. To have a body frozen costs as much as \$8,500; it costs another \$1,000 a year to keep it that way. Obviously no one can be sure that his family or friends will keep paying \$1,000 a year for ten, a hundred, or a thousand years, so the cryonics societies suggest that anyone planning to be frozen arrange his insurance and establish trust funds in such a way that an income for his maintenance will be assured.

Freezing is the best way to preserve biological material, but cryonics proponents are the first to admit that the freezing itself damages the body. Much remains to be learned about freezing damage, but some of the problems are known. Water expands as it freezes; expansion of water inside a cell can rupture the cell membrane, expansion of water between cells can crush them, and the freezing of any water can leave a residue of various salts in lethal concentrations. It appears possible that some of the physical effects of freezing can be obviated by freezing under such high pressure that the water cannot expand as it turns to ice.

So far, biologists have been able to freeze human blood and sperm. Both have been thawed and success-

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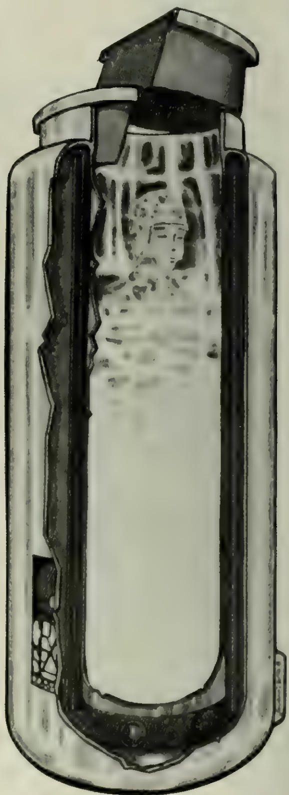
fully put to use. Earlier this year paper in *Nature* reported the successful thawing of frozen mouse embryos in England. A Japanese researcher found nearly norma electroencephalographic activity i a cat's brain that had been frozen Entire Arctic beetles have survive freezing.

Actually. more than thirteen human bodies have been frozen t date. The first was that of a California professor. James H. Bedford who was frozen in 1967. In a few cases. the families have since changed their minds and the bodies in question were later interred in the usual fashion. No attempt has yet been made to thaw and reanimate a frozen human being.

Suppose you have signed up to



This drawing shows a body. frozen solid at 320° below zero. waiting to be thawed out and revived.

frozen. and now find yourself ir death. What happens? First. u cannot volunteer to be frozen ile still alive. in the hope of pre- nting any further deterioration of ur body. Freezing unquestionably ls. and present laws do not per- t the freezing of a live person. no tter how much he desires it.

You can alert your cryonics iety (there are six in this country d one in France) to stand by. If ezing starts immediately after u are declared legally dead. no ther deterioration will occur.

At the point of death or at a yonics center. the body goes rough a process similar to em- lming. The carotid artery and the gular vein are opened. and liquids protect the body against freezing mage are perfused through the culatory system. The lungs are oded with the same liquid.

Next the body is enclosed in a astic pouch with crushed ice and anular salt touching the skin to duce the slow formation of ice ystals until the temperature is wered to 4° below zero. After a y of this. the body is wrapped in iminum foil (a movable flap ross the face permits easy identi- ation) and placed in dry ice. a ocess that lowers the temperature 110° below zero. The body can stored for months in this state til a final decision is reached and rther physical and financial ar- ngements are made.

Finally. the body. placed on a retcher. is installed in a round nk that is essentially a Thermos ottle. Liquid nitrogen is poured in. d at first the nitrogen boils away pidly. quickly lowering the tem- rature. When the temperature is w enough. the nitrogen stops boil- g. The tank is then completely led with the liquid nitrogen.

That body is now in cryonic sus- ension. awaiting the future. Main- nance consists of periodically ecking the internal temperature d replacing the nitrogen that va- rizes and escapes.

In addition to freezing human odies. individuals interested in yonics are experimenting with the eezing of tissue samples from imals in danger of extinction. ere again the idea is to preserve e genetic information until the ay when the animal can be repro- uced from this information.

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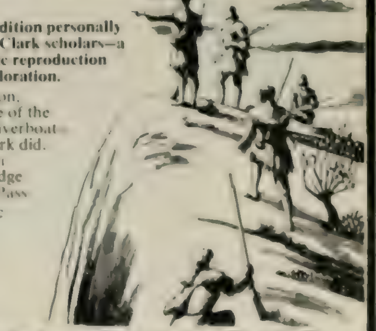

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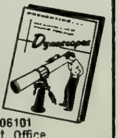

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...and the case against

by J. K. Sherman

The question of freezing human bodies arose during a news conference at a recent meeting of the Society fo Cryobiology, an interdisciplinary scientific group whose members study all types of biology at low temperatures. from basic aspects in hibernation of animals to the freezing of blood and sperm cells. The news conference topic was supposed to have been freezing damage to cells, but about halfway through, a reporter asked about the cryonics societies around the country whose interest is in freezing human bodies. Professor J. K. Sherman of the Department of Anatomy at the University of Arkansas School of Medicine offered a detailed explanation of why he feels such efforts are far too premature; the substance of those remarks, as well as of others he has made in the scientific literature, is printed here.

The Prospect of Immortality, a book written in 1964 by Robert Ettinger, has revived interest in an earlier proposal to preserve man by freezing. Unfortunately, it has also stimulated what I believe to be a premature, unscientific, and fruitless program of freezing human

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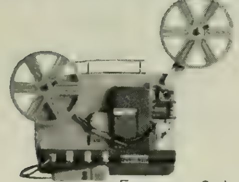

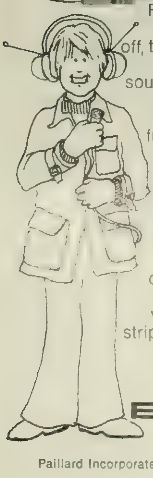

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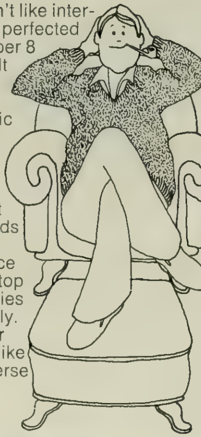

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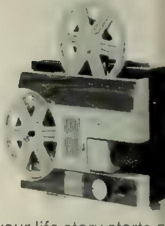

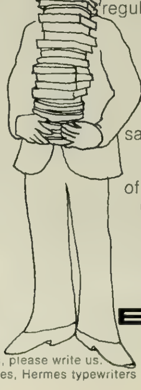

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beings shortly after their death. which does a disservice both to the community and to low-temperature biology.

In its essentials. the rationale behind the freezing of human bodies runs as follows. Mr. X has just died of cancer. At the moment he is declared legally dead. most of the cells in his body are still alive. Preparations made beforehand permit Mr. X to be frozen as soon after death as possible so as to maintain the potential viability of the bulk of this cell population. Thirty years later. a cure for his terminal cancer is discovered. By this time. a means of reviving the recently deceased is also available. Mr. X is thawed out. returning to his original postdeath. prefreeze condition. He is then brought back to life. cured of cancer. and rejuvenated. He lives on until he dies of another disease or of old age. at which time he is refrozen and the cycle repeated.

This scenario is within the framework of the thesis expounded by Ettinger in 1964—and followed by the cryonics societies—which stresses that: "(1) immortality is technically attainable. not only for our descendants but for ourselves: (2) the biological thesis of freezing corpses and rejuvenating them at a later date is practical and feasible. and does not raise any insurmountable problems: and (3) the prospect is desirable both from the standpoints of the individual and of society."

Banking of frozen human beings is now a reality in this country. if the only criterion is the existence of bodies stored in the frozen state. I believe thirteen bodies have been frozen and stored in liquid nitrogen to date. in accordance with the philosophy. procedures. and policies of the cryonics societies. Unlike banks for frozen human spermatozoa. blood. and tissue culture cells. however. human body banks have not been qualified as "proven." That is to say. no frozen human body from such a bank has been thawed for evaluation of the functional and structural integrity of its cells and for comparison of its condition after thawing with that at the time of freezing. There is absolutely no sci-

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entific accomplishment associat with the freezing and storage of a living material unless the desir application of the frozen storage demonstrated. In this case, the crit cal requisite aim is the preservati of the billions of cells that are sti alive at the time the legally dea body is frozen. To preserve as man living cells as possible, cryonics s cieties stress the need for proces ing and freezing bodies as quickl as possible after organismic deat In the absence of such demo strated preservation by freezin only predictions of failure can b made by those of us engaged in r search in these matters.

The principles of application tha underlie banks for frozen human are theoretically possible to realiz as are those principles for man other scientific dreams of men. It i my opinion, however, that curren frozen storage of man is unwarranted in the face of our limite knowledge of those factors associated with preservation by freezing. In the present state of the ar in this area of science, no mammal, no vertebrate animal, for that matter, has been preserved successfully by freezing. There are no functional banks for living organs, such as the heart or kidney, or for tissues, such as slices of organs. The obvious and documented reason for this deficiency is our current inability to comprehend the mechanisms associated with both the injury induced and the possible preservation afforded by freezing, storing, and thawing in the heterogeneous complexity of the higher organism.

Cryobiology, or low-temperature biology, is an emerging scientific discipline that is concerned with the singular events associated with life and death at low temperatures, primarily below freezing. Manifestation of these phenomena reflects the unique consequences effected by the crystallization of ice as it either preserves or destroys the fabric and functions fundamental to life.

The underlying principle of preservation by freezing is the control of molecular activity. Life requires biochemical change, which occurs through movement of molecules in an aqueous environment. If water in the protoplasm of living cells is converted to ice at temperatures low enough to essentially arrest this molecular movement, and

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if the biological system can be rewarmed without consequent damage, then the life of these cells ca be held in "suspended animation," or preserved by freezing.

The introduction in 1949 o glycerol as a cryoprotective agen provided a revolutionary impetus toward realization of some of the potential of this principle of preservation by freezing. Certain isolated mammalian cells, including spermatozoa and red blood cells as well as a number of normal and tumorous tissue culture cells, are routinely preserved by freezing, then stored in cell banks for industrial, clinical, and research application. Recent advances in organ transplantation in man, especially of the kidney and heart, have stimulated substantial interest in the banking of frozen human organs for clinical application.

Cellular injury or destruction, the antithesis of preservation, is the other feature of freezing that is of concern to some cryobiologists and, especially, to surgeons. Selective cryoinjury is the goal of those surgical techniques designed to destroy tumorous tissue, leaving behind the uninjured, healthy cells essential for rapid and complete repair. Zoologists and, particularly, botanists have known for several centuries that the process of freezing and thawing is capable of devitalizing cells by irreversible alteration of their structure and function. Cryosurgery is now an established field internationally.

Contemplating the reversible suspension of life processes in man by freezing, so that he might enjoy an ageless flight to planets normally several generations away, is overshadowed only by the weighty question: How can the protoplasm of his varied tissue cells, with its vital attributes, react innocuously to the extremely low temperatures necessary for preservation? The dramatic, empirically derived success in banking spermatozoa for the animal-breeding industry, for example, has been economically rewarding, but with the realization of this reward, research has receded to token interest. Yet of this relatively homogeneous cell population, about 30 to 50 percent of these cells do not survive freezing. Chances of successful preservation of a complex organ are remote in the face of such

ll loss or of the latent damage that
ccompanies cell survival after
awing and that appears with time.
here is a critical need for basic re-
arch in cryobiology in order to re-
ize the theoretical potential of
eezing in both organ or organism
eservation, as well as in cryosur-
ery.

Man, the human organism, is
mposed of various levels of bio-
gical complexity in his organiza-
on. Man's systems, such as the di-
stive, respiratory, and cardio-
scular, consist of organs, such as
e liver, lung, and heart. The or-
ns are built from four tissue
pes—epithelial, connective, mus-
lar, and nervous. In turn, each
sue is built from cells, the funda-
ental units of structure and func-
on in living systems. The cell's
tle organs, or organelles, such as
e nucleus, chromosomes, mito-
ondria, and endoplasmic reti-
lum, are in the next lowest level
complexity. Finally, the chemical
bstances and enzymes of these or-
nelles, with their molecular and
bmolecular composition, are at
e lower end of this organization
dder.

The nature of life and death at
w temperatures must be explained
timately in molecular and submo-
cular terms. Current knowledge in
yobiology is still insufficient to
derstand and explain manifesta-
ons of cryoinjury and cryoprotec-
on at any level of biological com-
exity. The approach in this field
s been largely empirical, and, al-
ough successful in the preser-
tion of various cells, has added
latively little to basic information
n life and death of mammalian
lls at low temperatures. Research
n factors affecting freeze-thaw sur-
ival of cells now requires observa-
ons at an ultramicroscopic (elec-
ron microscopic) level, with
arallel studies in biochemical func-
ons, to understand more fully the
lterations induced by direct or in-
irect effects of the formation and
issolution of ice.

The factors associated with pres-
rvation of living material by freez-
g include: (1) temperature shock
deleterious effects of rapid cooling
bove the freezing temperature), (2)
ates of cooling below the freezing
emperature, (3) size, shape, extent
nd location of ice crystallization,
1) presence and absence of cryo

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protective substances such as gly
rol. (5) final subfreezing tempe
ture reached. (6) storage time
this final temperature. (7) rate of
warming from the frozen state. a
(8) latent injury (freeze–thaw
duced alteration of function a
structure with time after rewar
ing), among others.

We must recognize that the h
man body contains billions of cel
representing more than one hu
dred different cell types with vari
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and life histories. These heter
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plus the levels of complexity, i
cluding environmental factors
the substances and fibers that su
round these cells. create a co
plexity of diversity in form, fun
tion, and most important, sens
tivity to stresses. such as the form
tion and dissolution of ice with
and around the cells.

Differential sensitivity from o
ganism to organism, system to sy
tem, organ to organ, tissue to tissu
cell to cell, organelle to organell
molecule to molecule is an estab
lished fact in biological scienc
The inherent reactions of the var
ous levels of biological organizatio
that make up man, therefore, wi
vary when exposed to the factors
cryosurvival associated with a
tempts at preservation by freezing
The problems and deficiencies i
cryobiology are thus apparent.

It is my considered opinion
therefore. as initially stated, tha
current banking of frozen corpses i
premature, fruitless. and unscienti
fic. with questionable value to th
community in general and t
cryobiology in particular. The reto
from the well-meaning and sincer
people in the cryonics societies
that those who will their bodies t
be frozen have nothing to lose. i
not enough to satisfy the expense
false hopes. and disregard for scien
tific direction that accompany such
philosophy. Rather. their effort
should be redirected toward suppor
of the concentrated research neede
to realize the theoretical potential o
the principles of application inher
ent in their program. The spin-of
from such research surely would en
able us to benefit from other aspect
of freezing's dual potential—th
preservation or destruction of livin
material in health and disease.

You can save Luz Marina for $15.00 a month. Or you can turn the page.

uz Marina Jacanamijoy.
n eleven year old Colombian
hild. Living with her parents and
ive brothers and sisters in a one-
oom house. The roof is straw and
he kitchen is a fire outside. No
lectricity. No medical care. None of the
hings so many of us take for granted.

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A PORTRAIT OF TINKERS

Ah, may Jesus relieve you in your hardesht hoult,
My lovely man. Like myself you are,
Black hair, brown eyes, yalla shkin,
That's your beauty and my beauty . . .
I love you, sir.
I love you for your hair, your eyes, your shkin.
It's in four o' me grandsons.
I got four after meself and four after their foxy father
(I can't stand foxy people!)
As sure as Christ was nelt, sir, I suffered my share,
But I have my health.
Indeed I have, sir.*

* Told to the author by a tinker woman.

A man, looking wistfully into the distance, sees the blue-green hills of Ireland and the creaming edge of the western sea. As he turns and scans his world, he sees a crude camping place; sees his children, as often as not, cold, smoke-blinded, ill-clad, hungry, and deprived. The man is a tinker, one of 7,500 such wanderers on the Irish highways who now find themselves at the crossroads of their existence.

Caught up in their last fight for the right to a nomadic way of life, one that has been theirs for centuries, these people are torn between the pull of tradition and the urge to educate their children in a manner free from the hazards and hardships of the road. Their own, sorry lot is a vivid contrast to what they see on television and in films, and they are under constant pressure from strata of society unsure of their own gentility.

As a tinker gropes to interpret, in terms of his own family, the frightening statistics of death among his people's young, his own illiteracy is ironically made apparent to him by his inability to read the notice hanging on the fence beside him—TEMPORARY DWELLINGS STRICTLY PROHIBITED. (This, in effect, means TINKERS KEEP OUT.)

Meanwhile, as traffic mounts on the roads he is pressed deeper into the remote boreens, the narrow side roads, of the countryside. Today a tourist could well travel the main roads of the Irish island and never see a tinker encampment, unless he mistakes a huddle of the modish

by Bryan MacMahon

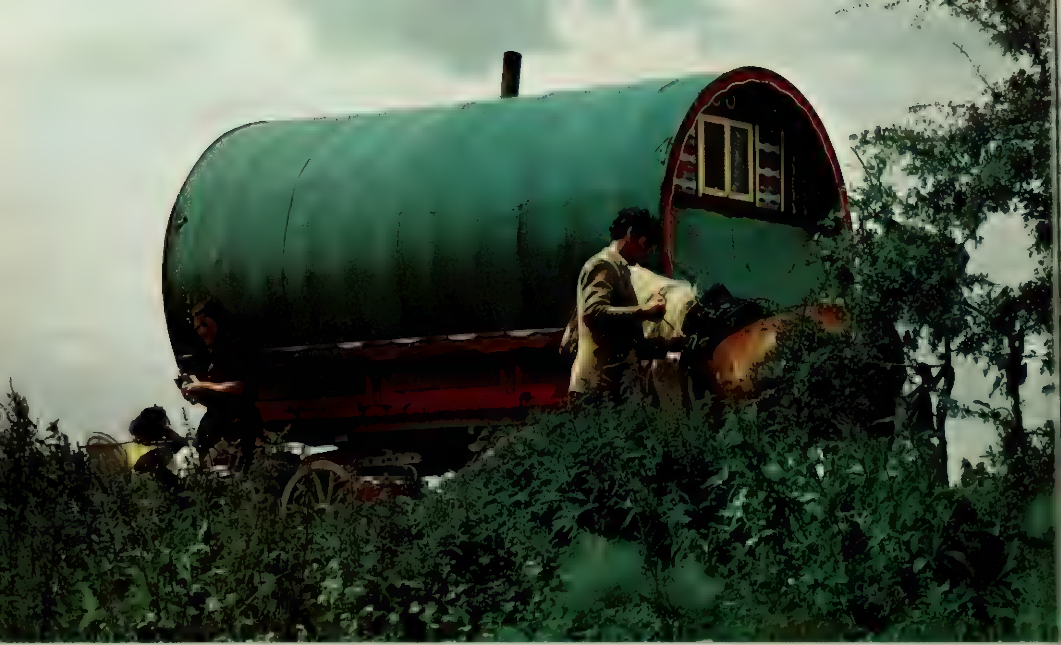
photographs by Mathias Oppersdorff

PORMATIC
GH SALTERTON
ENGLAND

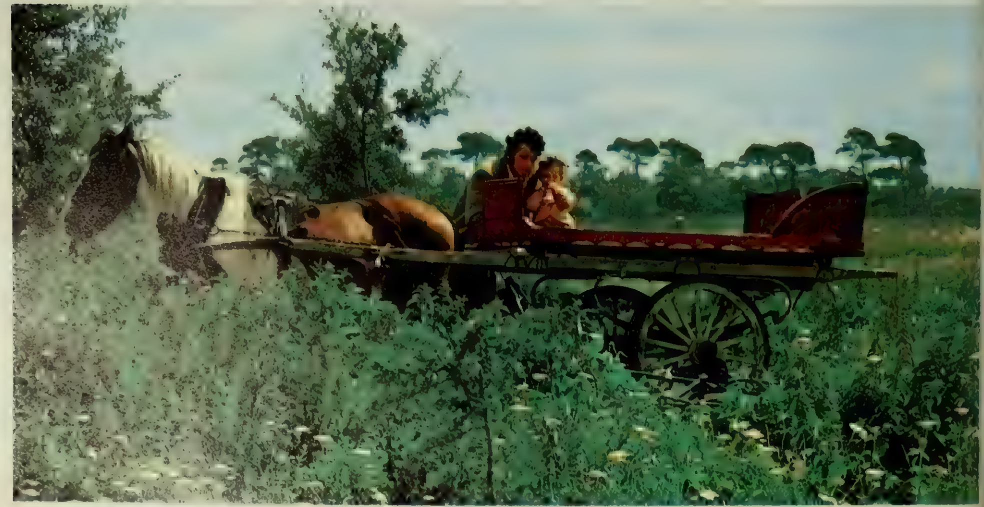
A tinsmith, below, hammers the seam of a metal pail. Because such containers have been replaced almost everywhere by cheaper, mass-produced plastic utensils, many tinker men have given up this traditional craft for a variety of other occupations, such as chimney sweeping or umbrella repairing. Right, a pause for a bottle of ale by the side of a little-traveled lane.

t is perhaps in the faces f the women. more han the men. that one detects he signs of a life lived lose to the rigors of nature. inker women marry young nd age quickly, and ears of arduous chores like he gathering of heavy loads f firewood demand stamina unfamiliar o women of more ettled existence.

Tinker children reflect the resiliency of youth everywhere and seem to belie the hardships of life on the road, until one considers how many of them perish in infancy. The promise of government-sponsored housing for traveling families and better educational facilities for these children has engendered both a hope and a conflict for tinker parents.



Home to most tinker families is a horse-drawn caravan, above, usually about nine feet long and five feet wide, with a bunk-type bed and a wood stove. In summer, or if they cannot afford a caravan, many families will use a flat cart, below, and sleep in tents. In recent years, a few tinkers have been able to purchase better-equipped motorized campers.



aravan-type vehicles popular mong continentals on summer oliday in Ireland—"pseudotin- ers" we call them—as being the enuine article.

As a rule the tinker favors the road margin under the hedgerows ' a hidden byway. There he is in a oot close to fresh water and rough razing, one where his fettered pie- ald horses are unlikely to stray nto the main traffic lanes. On such site, his tribe has encamped for enerations. It is one of the several amping places on the cut (Irish *uid*, or "portion") of his tribal ter- tory on which other tribes rarely ncroach, unless it be by tacit con- nt or as a consequence of a mar- age that binds clans in a tempo- ary alliance. Tinkers will also cross ach other's cuts while traveling to r from one of the traditional festi- als of Ireland: Puck Fair in Kil- rglin or the Listowel Harvest Fes- val of Racing, both in County erry; the Cahirmee Horse Fair in uttevant, County Cork; or the Gal- ay Races. Semireligious festivals ich as the Whitsun Festival at Bal- vourney in County Cork, held an- ually in honor of the local Saint obnait, draw tinkers from a wide rea.

Even when deserted, a campsite readily recognizable. The bushes ll about are festooned with the tat- ered rags of discarded clothes. here are dumped onions, a litter of vet straw, a blackened fire-ring, dds and ends of rusty iron, broken ilk bottles and, at a distance from he encampment, black bows of ex- rement, old shoes, finery that was haritably bestowed—laughed at by he recipient and then cast away—a oat bed or a dog bed, and a tat- ered fence from which all available irewood has been hewn and acked. The site may lie unoccu- ied for months on end, then is sud- lenly reoccupied for slim reason, nly to be abandoned again for eemingly no reason at all.

Inevitably one wonders about hese people where have they ome from and how have they man- ged to survive? Indigenous they ertainly are; the Irish tinker bears o relationship to gypsies of other ands, although he shares some likeness with his Scottish counterpart, the caird. He also has some affinity with certain traveling mule traders and barn sprayers of the southeastern United States, most of whom are at present centered in Murphy Village, South Carolina, close to Augusta, Georgia. But, otherwise, the Irish tinker is a native son.

Some historians have cited evidence for the belief that in prehistoric Ireland there were outcasts who lived beyond the circle of the Brehon Laws, the ancient body of common law of the Irish island. It is said they lived coarsely and in close communion with the clay, but they did possess the rudiments of craftsmanship and were addicted to music of a primitive sort. These outcasts supposedly skulked on the outskirts of the great pagan assemblies of ancient Ireland. Rather fancifully, the historians go on to suggest that the descendants of these outlaws persisted to the present day to become what we now know as the tinkers.

Other authorities advance the theory that the tinkers were native chieftains and their families who, dispossessed in the successive English plantations of Ireland, continued to hide in the neighborhood of their ancestral lands. With the passing years, instead of regaining what was rightfully theirs, their lot became still more squalid.

In favor of this latter theory is the undeniable fact that the tinkers of today bear the names of some of the noblest clans in Ireland—McCarthy (or Carty), O'Brien, O'Driscoll, McDonagh, O'Reilly, and O'Connor (or Connors). And, to some extent, it can be said that these are still associated with territories reckoned as the home of the eponymous ancestor.

A more prosaic explanation of their origin states that the tinkers were simply displaced or indolent or possibly even freedom-loving smallholders or laborers who huddled together in the wilder parts of the country. Choosing to live in their own individual, rough fashion, these people regarded the settled population as something to be preyed upon. As a natural consequence of this, they came to regard the forces of law and order as their natural enemies.

At some stage of their devolution, the necessity for a secret language must have become apparent to them. Such was sorely needed if one were covertly to warn a fellow outcast of the proximity of danger. And this brings me to the question of *Shelta*, the secret language of the tinsmiths, the more select tradesmen among those that we know as tinkers.

In his *The Secret Languages of Ireland*, R. A. Stewart Macalister mentions several secret tongues that once existed in Ireland, some of which have now almost completely died out. Examples he offers are Hisperic, Béarlagar na Saor (masons' dialect), bog Latin, and Shelta. I have also found among the tramps of the Irish roads traces of an international circus language and of a "broad gammon," the latter used by roustabouts and balladsingers—as well as faint traces of Romany, the international language of gypsies.

At one stage in my life, the secret language Shelta, variously called Sheldrú or Minkers' thawrie (tinker talk) or, more simply, gammon or cant, intrigued me so considerably that I went to pains to master it. In remote parts of the country this involved joining crowded campfires and pretending that I was a tinker who had made good by "flogging waxy" (selling linoleum). At such times I lugged along a cumbersome and primitive wire recorder that was a source of mystification to all. The language of Shelta I found to be mostly jumbled Gaelic or Irish with variants of considerable semantic and linguistic interest.

As an example of the derivation of Shelta I offer the common words *lackeen* ("a girl") and *soobla* ("a boy"). By rearranging the first and fourth letters of the Irish word *cailin* ("a girl"), it becomes *lacin*, which is almost identical in pronunciation to *lackeen*. Similarly, the word *soobla* is more or less an anagram of the Irish *buachaill*, with the harsh *ch* sound softened to s.

Since most tinkers in the past were illiterate, the study of Shelta poses the intriguing question of who first put this anagrammatic and extremely useful method of cryptocommunication down on paper. The originator was undoubtedly an accomplished letter juggler. It can be shown that the word *scoí-hop*, Shelta for whiskey, was derived by a devious process from *uisce beatha*, Irish for whiskey, although at first glance there is no apparent relationship between the two words.

As a guess I would identify the inventor of this cant as one of the dissolute priests or homeless monks who wandered astray in Ireland as the result of England's suppression of the monasteries and enforcement, in the seventeenth and eighteenth centuries, of the anti-Roman Catholic penal laws. If priest he were, this would account for the Latin word *panis*, which tinkers use alternatively with *durra* as the cant word for bread. But this is conjecture at its most fertile, even though it is supported by the analogy of such words as *hocus-pocus*, which is seventeenth-century sham Latin (in Ireland bog Latin). Hocus-pocus is insultingly imitative of *Hoc est corpus meum*, the words pronounced by the priest over the bread at the Consecration of the Mass.

Along with their secret cant and their fierce clannishness, tinkers have assured their survival down to the present day by a sympathetic, if wry, comradeship with small farmers and laborers. The Irish peasant, because of his own dire social and political plight, has long felt a certain kinship with the outcast.

To a varying degree, life for the majority of the older tinkers has changed little over the centuries. They respond to the wheel of the Irish year, continuing to move for reasons that are difficult to explain unless they be the normal or, indeed, abnormal exigencies and upheavals that beset the homeless. Often they move because the law is breathing down their necks for stealing something or other. (Tinkers aver that because a tinker befriended Christ by stealing one of the nails made for the cross, they were granted the right to take anything not nailed down! Their enemies state that a tinker actually made the nails, and as punishment, tinkers were condemned to wander forever.)

They also move from one place to another when they have worn out their welcome by being drunk and disorderly. A dispute between rival clans over some insult, real or fancied, or a blow struck in anger, which rankles as a slur on manhood, often causes families to move. Sometimes horses, donkeys, or goats stray onto the roadways or into paddocks and precipitate trouble. At times hard feelings result from the discovery of some imperfection in an animal that had been purchased in good faith.

Quarrels among tinkers are like earthquakes or acts of God. Occasionally they flame into open communal conflict in which peaceful villages are terrorized. The subsequent appearance of the battered clans in the lawcourts can be both boisterous and bitter.

As often as not, however, the sense of movement for its own sake is simply one of tradition: "When our father, or grandfather, was here in ages past, he next turned his face in such a direction and we for our part shouldn't break laws nor make laws." It may be a country festival that prompts a move—a regatta or a hurling or football match where rural excitement and rivalry insure plenty of free drink and ready cash.

It would not be entirely accurate, however, to view the life of the Irish tinker and his family as one of unremitting hardship. On the contrary, from early April, when the Irish skies are a dazzling blue, right through the summer until mid-October, when mists swathe the hills, the tinker's way of living is for the most part free, joyful, entertaining, healthy, and close to the prime dictates of nature. Worldly goods seldom encumber his movements: the lower ranks of tinkerdom possess little more than a flat cart, a piebald pony, a flashing harness, a hooped tent of green canvas, a ground sheet of sorts, a kettle bar, and a few blackened cooking utensils.

The tinker wife, often a girl in her teens, carries her baby wrapped in the crook of her brilliant green and red rug-shawl. As alibi for her begging, she carries a wicker basket containing a variety of goods—broadsheet ballads, Sacred Heart badges, camphor balls, and gewgaw brooches. The kitchen door of a tourist hotel often delivers up an assortment of victuals, which when eaten from a swatch of newspapers or later cooked, Irish-stew fashion over the campfire, insures that hunger is kept at bay. If her baby has not yet arrived, the young wife might carry in her shawl a bundle of clothes to simulate one, thus evoking the passerby's pity.

A future tinker mothe
clutches a ragged doll

The tinker's traditional trade of tinsmith has been hard hit by the widespread use of plastic utensils, and tinker men now tend to engage in a variety of occupations, although the tinsman is still much respected. The others collect scrap iron, car batteries, feathers, and horsehair. They clean chimneys, mend umbrellas, clean the dry latrines of country schools, hawk garish linoleum door to door, and sell shamrock sprigs on St. Patrick's Day and red-knobbed holly at Christmastide. They have even acted as film extras. I have traveling children attending my school who whoopingly took part in crowd scenes in such films as *The Playboy of the Western World* and *Ryan's Daughter.* And they seemed to take it all in stride as a natural part of their colorful life.

If a family owns a caravan, the vehicle is left at the campsite during the day while man, wife, and children, riding on a flat cart (nowadays they tend to use blue motor vans), range far and wide across the countryside in search of pickings. At nightfall they return to the caravan, there to kindle a fire of sticks and cook the main meal of the day. They may be joined from time to time by other vehicles of the clan until eventually there are eight or nine caravans in a line along the roadside.

With the arrival of dusk the

Continued on page 104

8

NAKED GILLS AND

Nudibranchs have evolved some brilliant colors and odd shapes—as well as some very effective defenses

by Warren Zeiller

To me, the soft, brown, curious-looking creature gliding through the garden or blazing moist trails across the sidewalk is little more than an agricultural pest. One, nipped and teased by my Irish setters, soon continued on its way, unhurried and unscathed. Both pups had disengaged rapidly from the encounter, their lips curled back, tongues and jaws smacking, and copious freshets of saliva washing away what must be one of nature's more unpleasant taste sensations. The common garden slug, a mollusk without a protective calcareous shell, has perpetuated life with a special defensive mechanism. Something about it—perhaps taste, smell, or both—makes it unacceptable to most predators.

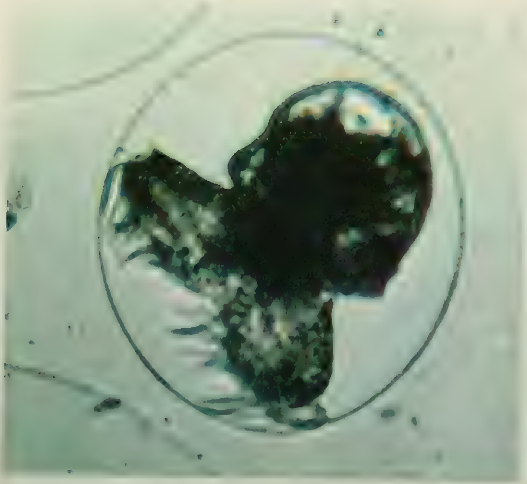
The oceans of the world give birth to animal forms of similar nature, the nudibranchs. As larvae they are consumed by creatures that feed upon plankton. But like their terrestrial cousins, the comparative few that reach adult stages appear to be free from predation because of their horrendous flavor. Rather than relying on the slugs' somber adaptive coloration for the additional defense of camouflage, however, the nudibranchs are textured with frills or ruffles and are often lavishly colored. Apparently this flamboyance advertises their distastefulness, and other creatures, unlike my pups, appear to recognize this.

Nudibranchs are invertebrates, one order of mollusks of the gastropod class. Thus they are closely allied to the spiral-shelled snails of land or fresh and salt water. However, in nudibranchs the shell forms during embryonic development and is then lost. Dorsal outgrowths—some winglike; others, frilly tufts or spurs known as cerata—take the place of respiratory gills. These outgrowths give the group its common name of nudibranch, naked gill.

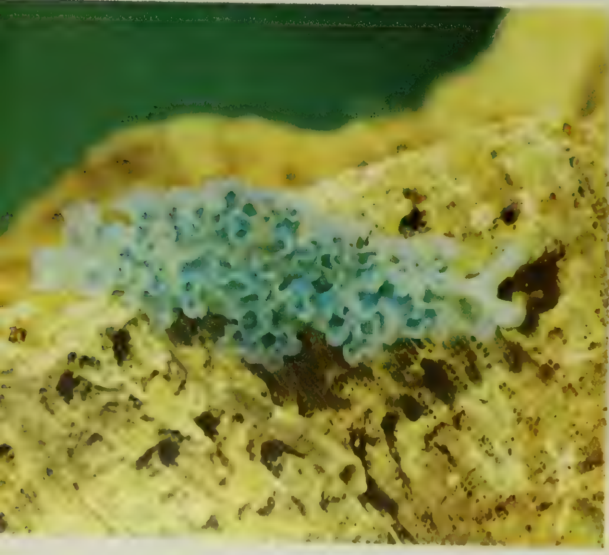
The complex reproductive system is hermaphroditic, but

A spurred nudibranch about two inches in length creeps along in search of its preferred food, sea anemones.

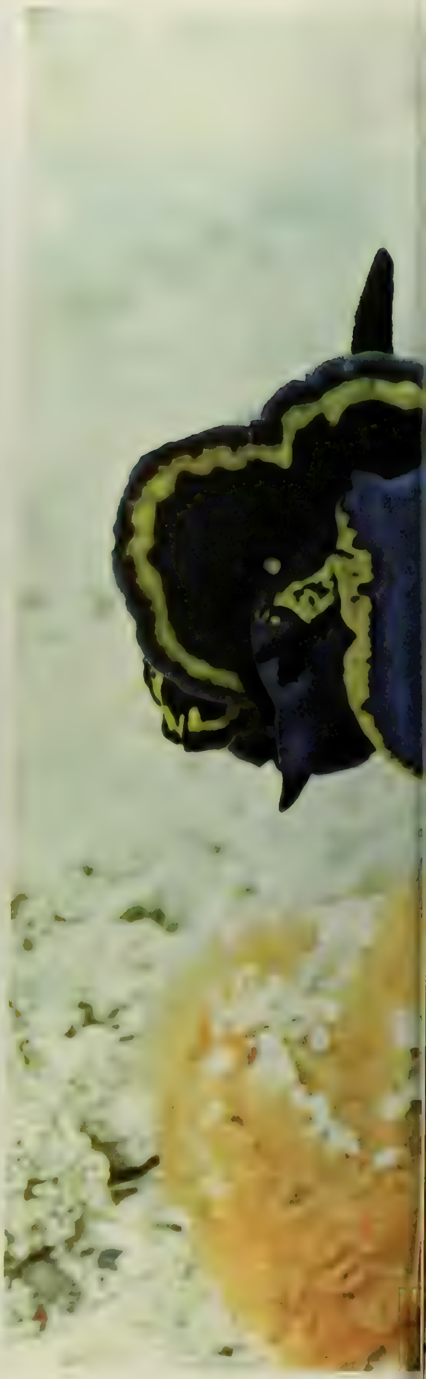
RECYCLED STINGS



The ten-day-old larva of a Greek goddess nudibranch has developed lobes covered with tiny hairs, below and left of the main body, which enable it to swim.



The ribbon nudibranch may display green, blue, or white patterns. This specimen is about an inch long.



A three-inch Greek goddess nudibranch completes laying of an egg mass containing thousands of eggs. Most will hatch within two weeks.

n this larger-than-life
iew of a piece of
riftwood in an aquarium,
ie hunter becomes the
unted. The gooseneck
arnacles at left use
ɔng "feet" to sweep
ie water for food.
esting on another
arnacle shell, lower
ight, a small feathered
udibranch prepares to
at a barnacle.
'he meal will turn the
udibranch brown; when it
eeds on by-the-wind
ailors, it turns blue.
'he round filigree object
bscuring part of the
udibranch is its egg case.

nudibranchs seldom practice self-fertilization: when two unite side by side, each plays the role of male and female to the other. Eggs are laid in gelatinous coils. The period of egg incubation is highly variable, ranging from a matter of hours for one species to several weeks for others. Each embryo develops amid thousands of others of its kind—but alone. There is no parental care or brooding by the adults. Some of the young hatch as crawling juveniles. Others form a swimming organ, or velum, from a pair of lobes covered with movable hairs called cilia. I could hardly take my eyes from the microscope the first time I saw these tiny hairs thrashing rapidly, but purposefully, rotating the larvae at a dizzy pace within the egg. The hatched larvae are known as veligers. Reacting positively to light and negatively to gravity, they swim among surface plankton for a time. Thereafter, their reactions are reversed and they settle to the bottom for metamorphosis. Buds on the body grow into various external sensory and respiratory organs. The body elongates and flattens into a broad foot (hence the name gastropod: *gaster*, "belly"; *podos*, "foot").

Now the juvenile nudibranch begins its lifelong quest for food, dining on encrusting organisms such as sponges or algae. Members of at least one group, the Eolidoidea, ingest the stinging tentacles of coelenterates (hydroids, jellyfishes, anemones, and corals). In these nudibranchs, undigested and untriggered stinging cells are carried to the spurlike cerata and stored in sacs. When the animal is irritated, the stinging cells are ejected. This borrowed ammunition serves admirably for a first line of defense against some bungling would-be predator that does not recognize the nudibranch as anything but a gastronomic delight.

The second or third pair of sensory tentacles on the nudibranch's head, tipped with neat rows or rings of tiny, leaflike appendages, are the rhinophores. Some types of rhinophore resemble rabbit ears, and one family, the Aplysiidae, which is closely related to the nudibranchs, has been given the vernacular name "sea hares." Rhinophores appear to be olfactory in function and may be used to locate food. Perhaps they serve as a sort of early warning chemical defense system as well; upon potential threat of harm, rhinophores and other delicate external organs are withdrawn and sheathed within the safety of the body mantle.

Small and harmless, but not without their own methods of defense, nudibranchs have evolved into a form well adapted to their life in the sea. They thrive in a world of predators, even as garden slugs survive the onslaughts of my pups.

Sky Reporter

Is Anybody Out There? Four times in the last decade men have listened for messages from other worlds, but so far have heard nothing more than the natural hiss of the universe, punctuated by the steady signals of radio-emitting celestial objects. It may be that we are listening with the wrong equipment or listening at the wrong time. It could also be that no one else is out there, but despite the failures to date, an increasing number of scientists are becoming convinced that we are not alone in the universe. Perhaps there's not a beep to be heard because nobody is sending; everybody is listening.

The search is continuing; radio astronomers are sweeping the sky for signals, any kind of signals at any wavelengths. Unlike national space programs, at least up until now, the search is evolving in a noncompetitive way. In any conversation with another civilization on another world, we are all Earthmen. Russian and American experts met in September to coordinate their efforts, establishing a joint committee to direct future efforts.

The question of extraterrestrial intelligent life has reached the stage of serious discussion. Astronomers are convinced that planets around a star are a common, rather than a rare, occurrence. Biologists are convinced that life can arise elsewhere, just as it did on the earth; not only are the precursor chemicals likely to occur on other planets, but they are also now known to be present in the gas clouds from which stars and planets condense.

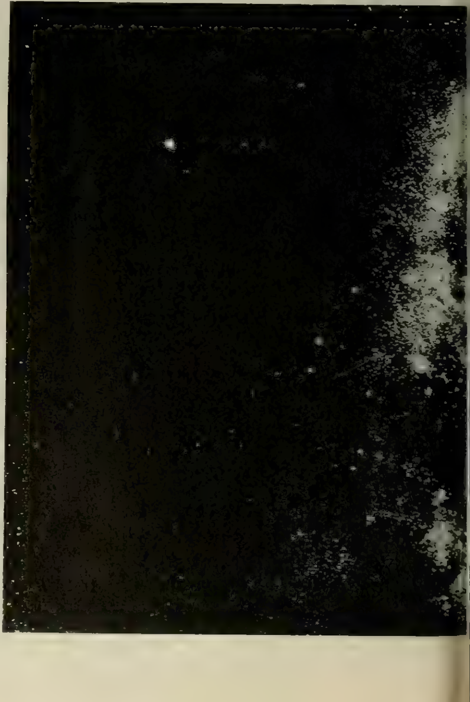
A separate question is how long intelligent life lasts once it does arise. Not a few students of life on earth feel that the life-span of our own technological civilization may be measured in decades rather than millennia. If we, for example, were to send a signal out to the stars today, and fifty years from now it reached another civilization, would we still be here when their answer arrived in another fifty years?

Some experts are more optimistic, at least about other civilizations. It may be that if a civilization survives the first few decades or centuries in which it has acquired the power to destroy itself, it can survive for eons. A civilization in a solar system much older than ours can be expected to have a technology capable of things men do not yet dream of; such a civilization might choose to signal, for example, by changing the characteristics of its star. It might have starships tha approach the speed of light so closely that when a cre returns from a voyage of a thousand years, they wil have aged only ten years or so.

In a sense we have already sent a signal to the stars A civilization several tens of light-years away ma have picked up the high-frequency radio and televisio transmissions that began on earth in the early part o this century. They may have promptly dispatched reply, a message that will arrive tomorrow at 3:00 P.M

The text is unlikely to be, "Hello, Earthmen, this i the Galactic Confederation. Our Welcome Wagon i on the way," or "Prepare to surrender to our warships." The message is more likely to start with something like a series of prime numbers to quickly identify it as the product of intelligent beings. The first "words" we hear could be groups of dashes representing the prime numbers 2, 3, 5, 7, 11, 13, and so on.

It takes a lot of energy to send a message over interstellar distances, so any message we pick up will probably be both long and full of information. In his novel *A for Andromeda*, the British theorist Fred Hoyle sug-



This rich star field, where the Milky Way crosses the constellation Cygnus, gives some idea of the billions of stars in our galaxy. And there are billions of galaxies. Many astronomers believe that somewhere in all of this, other intelligent life exists.

gested that the message might be specifications for a omputer.

How would another civilization open communications with us? To them, we are unknown creatures of presumably different form, culture, and even thought processes. One obvious solution is to transmit pictures, perhaps using a binary code that would instruct us which squares on a grid to darken and which to leave blank. A beginning vocabulary could be worked out from the pictures.

What are the chances of hearing from another civilization? Stephen Dole, in a study published as *Habitable Planets for Man*, estimated that in our galaxy alone, there are 600 million planets capable of supporting life as we know it. More importantly, he calculated that there would be one such planet within 27 light-years of the earth, two within 34 light-years, 5 within 47 light-years, 10 within 59 light-years, and 50 within 100 light-years.

The Russian astrophysicist Iosif S. Shklovskii and the American Carl Sagan, in *Intelligent Life in the Universe*, came up with an estimate for the number of civilizations in our galaxy technically superior to our own. They placed this number between fifty thousand and one million, which would put the distance between technical civilizations in the range of a few hundred to a thousand light-years.

These estimates do not really tell us what the chances are of hearing from another civilization. But the people who know best think the chances are good enough to make a search worthwhile.

At the September conference in Soviet Armenia, the Russian and American participants concluded that "for the first time in human history, it has become possible to make serious and detailed experimental investigations" of extraterrestrial civilizations and their detection. Some of the suggested lines of inquiry, they admitted, would cost as much as existing space and nuclear programs, but others could be initiated on "a very modest scale."

The Russians paved the way for future cooperation by revealing details of their most recent searches. As the conference participants put it, "It seems to us appropriate that the search for extraterrestrial intelligence should be made by representatives of the whole of mankind."

The interim working group they established includes four Russians, a Czech, and four Americans: Frank Drake and Carl Sagan of Cornell University, Philip Morrison of MIT, and Bernard M. Oliver of the Hewlett-Packard instrument company.

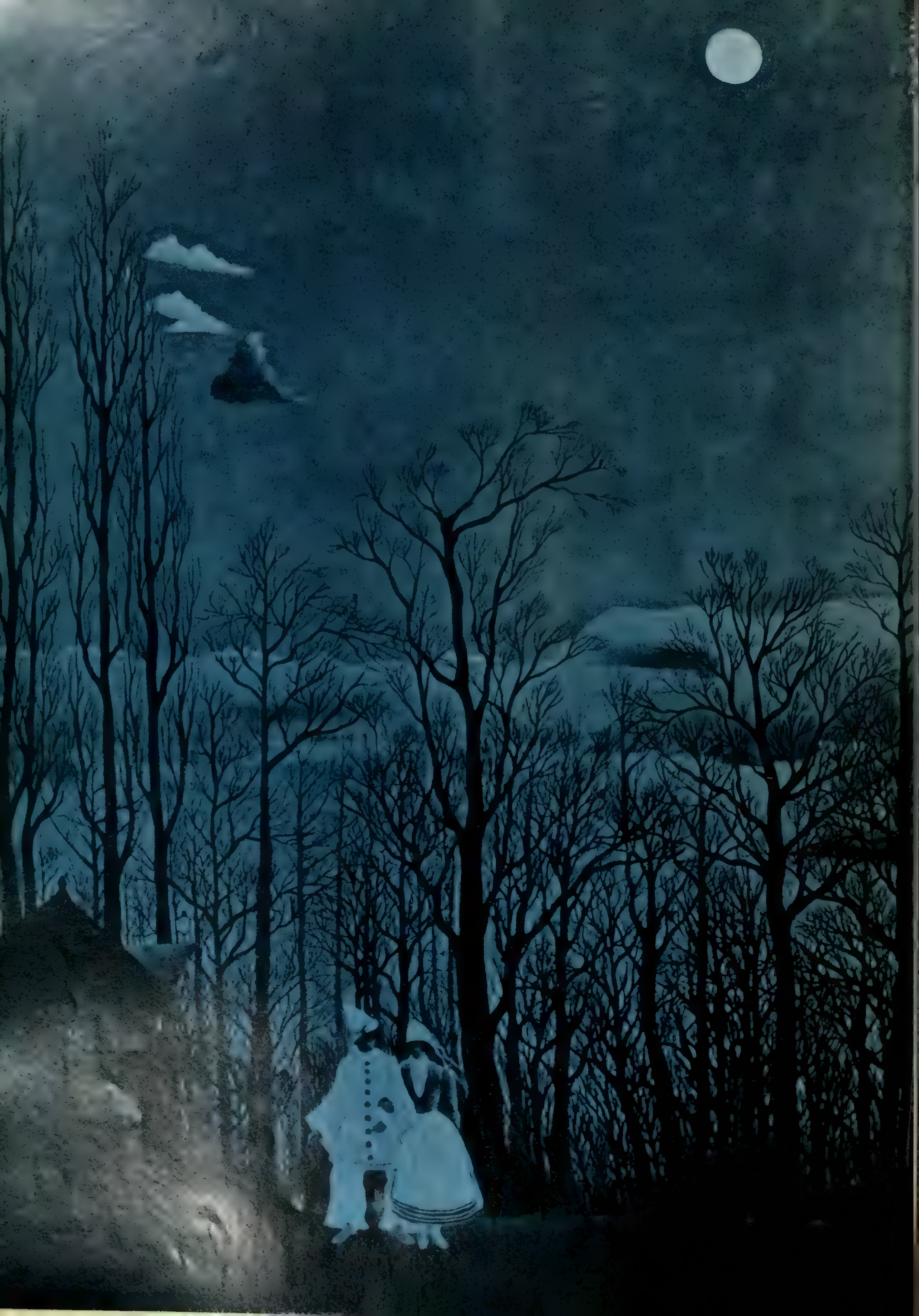
Two Soviet searches are continuing. In one, a 50-foot radio telescope is examining 50 nearby stars at what are believed to be logical wavelengths for signals. Twelve have been checked so far; the rest will be as time can be taken from other observing programs.

In the other program, short bursts of radio noise are monitored at observatories in Gorki, Murmansk, the Crimea, and Ussuri. This search is designed to be sensitive at all wavelengths. Any radio receiver can pick up a sudden electromagnetic burst, even if it comes from the flicking of a light switch in the next room. The listener has no way of knowing whether such a burst is local. But if receivers separated by a continent pick up the signal simultaneously, it can then be assumed to be coming from space.

No search is going on in the United States at the moment, but at least one group is putting together a proposal for a search to be undertaken at the National Radio Astronomy Observatory in Green Bank, West Virginia.

We may never hear from another world, but it would be so interesting if we did that it certainly seems worth the effort to listen.

John P. Wiley, Jr.



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PLAY

We do not know when man begins to play. Play may start before birth, with the kicks and turns of the fetus; it certainly is present in the infant; and it continues throughout our lives.

When play is suppressed, both the individual and society suffer. When play is encouraged, both benefit. The reasons for this are not clear, but somehow play is essential for man and many other social animals.

Unlike most behavior, play has not been exhaustively studied. Scientists have difficulty taking it seriously. They argue about what play is. Some have narrow definitions; others would agree with Tom Sawyer that "work consists of whatever a body is *obliged* to do. . . . Play consists of whatever a body is not obliged to do."

Play has a major role in the natural history of many species. Some of the importances and intricacies of play are discussed in the five articles gathered for this special supplement. Their meaning may be summed up in a paraphrase of a popular saying:

"Play is healthy for children and other living things."

Photo: Morton Tadder

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Man at Play

Since the beginning of the Industrial Age, Western society has suppressed play. Only now are we starting to realize the penalties of that abnormal repression

by Edward Norbeck

Department of Anthropology
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America's forefathers believed strongly in the set of values known as the Protestant ethic. Devotion to work was a Christian virtue; and play, the enemy of work, was reluctantly and charily permitted only to children. Even now, these values are far from extinct in our nation, and the old admonition that play is the devil's handiwork continues to live in secular thought. Although play has now become almost respectable, it is still something in which we "indulge," a form of moral laxness.

Anthropologists have long known that non-Western societies seldom value work for its own sake. Most people, in most times, have not worked hard. Today even for the most primitive peoples, who scratch out a bare livelihood by hunting and gathering wild foods, life does not consist of unremitting hard work. Prof. Richard Lee has shown that the modern !Kung Bushmen of the Kalahari Desert of Africa, for example, work only 12 to 19 hours weekly to provide for themselves. A recent anthropological study places the beginning of lengthy and regular work perhaps ten thousand years ago, following man's invention of plant and animal husbandry, when planned programs of regular labor became necessary for economic success and when small children could regularly be put to economically useful tasks such as tending livestock. A sustained cycle of hard work is a phenomenon of modern times, limited principally to the industrialized nations of the world.

In many societies attitudes toward play, as well as toward work, also differ from those prevalent in the United States today and especially from those that prevailed in the recent past. In most societies play has not been a sin or even a foible. Instead, it has been viewed as an outstanding and socially approved feature of life and has often held a position of honor in religious observances. The idea that play is frivolity and not the proper business of life has a history of some centuries in Europe and the United States. This thinking has doubtless played a part in spurring the economic and scientific development of our nation. Although there have been some exceptions, the general neglect of human play as a subject of study also reflects this idea.

Since the turn of the century, biologists have studied play, but they have nearly always been concerned with the play of lower animals, a permissible subject. Physical anthropologists, dealing with apes, monkeys, and other lower primate relatives of man, have similarly made some studies of play. For many years therapists and educational and social psychologists have studied the play of children, but, in one way or another, these studies have generally concerned work or have had therapeutic goals. For example, many studies have been made of the value of play as a vehicle of learning, of children's play that seems to mime the behavior of adults.

Similarly, the study of recreation, now very popular, concerns principally its relation to work. As Margaret Mead has observed, financial support for the study of play among adults has generally been available to social scientists only when play is called recreation, a label that identifies its role in recreating human beings for the serious and proper business of life.

Human play need not be regarded as simply a restful diversion from more important activities or as the behavior of children. Play is both a biological and a sociocultural phenomenon that has significance in many ways, some of which concern modern social problems.

For all forms of life, play may be defined as voluntary, pleasurable behavior that is separated in time from other activities and that has a quality of make-believe. Play thus transcends ordinary behavior. Human play differs uniquely from that of other species, however, because it is molded by culture, consciously and unconsciously. That is, human play is conditioned by learned attitudes and values that have no counterpart among nonhuman species.

Following our definition, forms of human play include sports and games of all kinds; dancing, singing, wit, and humor; dramas, comedies, theatrical performances, and other forms of mimicry; art, music, and other esthetic endeavors; and induced states of psychological transcendence, such as those resulting from alcohol or drugs.

The research of biologists and primatologists shows that play is innate behavior in the entire class of mammals and that play sometimes occurs between individuals of different species. Man plays with cats, dogs, and other domesticated animals; cats and dogs sometimes play with each other; apes and monkeys (chimpanzees and baboons) have been observed in nature as playmates.

Among the many forms of life, man is the supreme player. Only man appears to play from birth to death, although forms of human play tend to change as humans age. Some societies have discouraged or even prohibited certain forms of play, such as dancing. But the impulse to play is irrepressible, appearing unmistakably in every normal newborn child. Our closest living relatives, the apes and monkeys, also do much playing. It seems the more advanced a species is on the evolutionary scale, the more frequent and diverse are its play activities.

The theory of evolution holds that any biological trait endangering a species' survival will be eliminated by natural selection, while a trait with value for survival tends to become established by the process of natural selection. If we accept the idea of natural selection—and I for one do—we are faced with the problem of finding survival value in human play. Curiously, the evolutionary significance of play has never been a matter of much interest to biologists or physical anthropologists.

In trying to understand the biologically adaptive

Carnival, Trinidad Tourist Board

value of human play, it may be useful to regard man's retention throughout his life-span of the capacity to play as being neurophysiologically linked with youthfulness, and the acts of play as having vitalizing neurophysiological effects. An examination of the occasions when play occurs so suggests. Some information on nonhuman species indicates that play is most common and intense when disjunctions occur; that is, at the time, or soon after, changes in bodily states produced by internal or external stimuli have occurred, such as upon awakening from sleep or when the weather or other features of the physical environment induce changes in behavior. A study of wild African lions, for example, reports a heightened incidence of play at such times, and chimpanzees have been observed to play more when it rains. Play itself seems to be a change in pace occurring transitorily when other changes in pace come about.

Human play is also linked with discontinuities: changes in kinds of work, the completion of any time-consuming project that focuses on one kind of activity, changes in social status. The great festivals of human societies occur at junctures in the annual cycles of economic activity, such as breaking ground, planting, and harvest. These, in turn, are connected with changes in the seasons. The traditional Christian festivals may be traced to such times in the agricultural calendar of the eastern Mediterranean lands where Christianity emerged. Play behavior included in rites of birth, coming of age, marriage, and funerals takes place at a time when human roles change: the youth becomes an adult; the single girl becomes a wife; the childless woman becomes a mother; and the bereaved wife becomes a widow.

All important social events in the lives of individuals tend to be incorporated into social observances, and these events commonly include a rich element of play. For example, in many societies funerals are traditional times for play. In man's history, many play activities have been elements of ritual events. In addition to the social motives involved in the celebrations, it seems probable that an unknown physiological stimulus exists. We are all familiar with the urge "to do something," to celebrate, when we have finally brought to an end a line of prolonged activity, whether its goal was a college diploma or a knitted comforter.

Games existed long before history was recorded; for example, there is ample evidence that the ancient Maya used a rubber ball in a game they played on elaborate masonry courts. Both divination and games of chance are also ancient. Intimately connected, many of our games of chance began as forms of divination.

While information on some forms of play is incomplete, we know that the supposedly humorless North American Indians were often anything but dour among their fellow tribesmen, and that so-called inscrutable Orientals are, to themselves, quite scrutable, practicing wit, humor, and other forms of play. But understanding the wit and humor of these and other foreign societies requires such intimate knowledge of their languages and cultures that ethnologists, lacking comprehension, have often omitted the subjects or have casually reported the existence of wit and humor without providing any account of their nature or themes.

The types of play are everywhere fundamentally alike. The common and uncommon forms of play, however, differ considerably among societies, even among those of similar cultural development. Water skiing is not possible in the Sahara Desert, of course, but many of the differences in play have no relation to the physical environment or state of technological development.

Cross-cultural comparisons of play can tell us something about the reasons for the differences. Why, for example, do the modern Japanese strongly favor baseball, bowling, skiing, and native sumo wrestling, three of which are introductions of modern times from the West? And why do they disfavor football, prizefighting, and Western-style wrestling? Like other forms of play prevalent in Japan, the preference in sports is congruent with ingrained attitudes and values of which the Japanese themselves are scarcely conscious. The popular sports all preserve physical, and thus also social, distance, which accords with the custom among Japanese adults of avoiding physical contact in public, of preserving social decorum at almost all times, and of following clear-cut rules of procedure in the acts of life.

Physical contact in sumo wrestling is momentary and highly stylized; the rules of the game prescribe elaborate formalities of procedure throughout, and moreover, the sport is performed by professionals. Except for a small group of professional wrestlers, it is a vicarious spectator sport. Physical violence, so much a part of prizefighting and football, is looked upon in Japan as highly improper behavior, an idea that is passed on to young children.

The industrious Japanese are not slaves to work. Play holds a place without dishonor in their lives. All pleasurable acts are acceptable behavior, provided they are not socially disruptive and do not stand in the way of obligations to other members of society. Feelings of guilt for "indulging" in pleasurable behavior at the appropriate times is not Japanese.

The attitude in Japan toward alcohol and drunkenness tells us much about Japanese views of play. Drinking on the part of male adults has traditionally been approved under the conditions earlier described, and drunkenness is not a violation of the law. The goal of drinking is often to get drunk, a state in which one is not really accountable for his actions and during which many conventions are broken. Offenses committed while drunk have been traditionally condoned on the grounds that the offender was understandably not himself. But modern times and—I must add—numerous automobile accidents have changed this attitude somewhat, and recent legislation provides penalties for drunkenness while driving.

Examples such as those given briefly for Japan can shed light on the habits of play of the United States, particularly through the contrasts that become evident. In this way we may see that some of our current social problems are linked with our attitudes toward play and, consequently, our inability to play satisfactorily. The Puritan ideal in the United States contrasts sharply with attitudes in Japan, where motivation to achieve is no less powerful as a stimulus to work and to the economic development of the nation. The American way of not so many years ago was six days of labor and one day of "rest," a day that ideally was given to devotional tasks, certainly not to play. One offered thanks for the bounty of existence and for the six days of labor.

But the grip of the Protestant ethic on the United States has begun to relax. The past several years might be called the dawn of the rediscovery of man's animal nature, the discovery that man shares various hereditary traits with apes, monkeys, and lower forms of life. We have recently dared to openly acknowledge that sexual behavior exists among human beings, and some of us now avoid saying or thinking that people "indulge" in sexual acts. A few of us have taken a larger and perhaps more perilous step in stating that play is natural human behavior, serving an essential role in the maintenance of life.

In all human societies, but perhaps especially in those holding the Christian view that man is a special creation, any behavior that calls attention to the nature of man as an animal is strongly conditioned, controlled, or even suppressed. All necessary bodily functions—eating, drinking, excreting, breathing, and sleeping—are bound by firm conventions and should ordinarily be performed as unobtrusively as possible. It was scarcely possible to imagine that beneath the demeanor and substantial garb of the Victorian lady lay a busy alimentary canal. Ponder for a moment the probable effect of flatulence in public or of the frank scratching in public of certain parts of the body on the careers of politicians, ministers, or university professors. For many, human copulation was unseemly behavior, so animallike that the anatomical reminders of sexuality were concealed by garments that sometimes remarkably altered the contours of the body—and led to amazing symbols of eroticism.

These and other suppressions of man-animal behavior have been important and, in the sense that we and our culture would otherwise be very different, were probably required in the biological evolution of man and the development of society and culture. As anthropologists have often said, man domesticated himself. The trend toward suppressing the beast within reached its greatest height in Europe and the United States, where it included attempts to suppress play as a matter of morality. Only very recently have we been able to think that perhaps we went too far, that we unwittingly created a complex of social problems for ourselves.

Elsewhere in the world, among non-Western people (and among Western people not too many centuries ago), play was wholly acceptable behavior. Potential problems of unregulated play did not exist in these societies because play was institutionalized. All types of play existed and were permitted under conditions of regulation that kept them in order and, in ways that I shall try to make clear, contributed to social harmony and personal well-being. The most important means of regulation in the past was to convert forms of play into religious activities, which were then permitted or even required on certain fixed occasions.

One of the most common examples of play in religious dress is the rite of reversal, of upside-downing, during which the social hierarchy is inverted, customary rules of moral behavior are suspended, and other ordinary behavior, such as the direction of walking and dancing, is done backward. Commoners may insult kings, women may deride men, and all kinds of resentments may be expressed with impunity. Obscenity, lewdness, sexual license, theft, and assault or mock assault may all be permissible. Mimicry, drama, wit, humor, song, dance, pageantry, alcoholic drunkenness, and other forms of induced euphoric transcendence may all be incorporated in the rites.

But let us note that the festivals are not truly chaotic. Order prevails within seeming disorder. Reversals begin and end at fixed times; all participants know the rules, and all are well aware of the quality of make-believe and the transitoriness of the festival behavior.

Rites of reversal have sanctioned play during most of human history. They were once common—and traces still exist—among native peoples of sub-Saharan Africa, North American Indians, Polynesians, and elsewhere among nonliterate peoples. Among the elaborate civilizations of the world, the Hindu festival of Holi, the ancient Greek and Roman saturnalia, and the European festivals of Mardi Gras and Carnival are all examples of rites of reversal. All are fundamentally complexes of forms of play. Although once common in northern Europe, the birthplace of the Protestant ethic, today these rites linger in Europe only as echoes among Roman Catholics. As the Protestant ethic spread from Europe, the once widespread rites of reversal faded, although they continue to survive in many societies. It is not surprising that they are unknown in the United States, except in the Mardi Gras of New Orleans, a mere afterglow of the original rite.

This sanction of play in rites of reversal has had implicit positive functions: the rites promote well-being and social order in ways of which their participants are unaware. The rites may easily be seen as valuable safety valves for both individuals and social groups. Many Americans might see such value in the African rite that allowed men to berate their mothers-in-law. The return to ordinary rules of behavior after a departure from them may also be seen as reaffirmation of the propriety of the everyday rules. The rites also provide, with social approval and encouragement, opportunities for esthetic expression as well as for other forms of play. Permissiveness accompanied by control prevents play from getting out of hand. I am aware of no report on primitive societies under native conditions that even suggests that play is a social problem.

One of our difficulties has been that our attitudes toward play have not dimmed our impulses to play. Even when disfavor was at its peak, we continued to play—usually unobtrusively, by recourse to the least disfavored forms, and often surreptitiously, illegally, and guiltily. Of course, not all people were taken in by the prevailing conventions and many did continue to play.

An acute social problem facing us today concerns a form of play that we have seldom recognized as such, one that other societies have been able to handle by regarding it as normal, if remarkable, behavior. Taking a drug trip is not a corrupt innovation of modern youth, but an ancient practice among humans everywhere. Transcending ordinary psychic states is attractive to people of all ages. Children like to be swung by their hands and to turn round and round until they are dizzy. They like to ride roller coasters at amusement parks. Adults also seek transcendence, in many ways and to many degrees. We have called its various forms by many names: escape, fantasy, mysticism, trance, vision, revelation, ecstasy, talking-in-tongues, religion, drunkenness, and, sometimes, drug addiction. Ways of achieving these states have included fasts, self-torture, hyperoxygenation, dancing and other forms of physical exertion, suggestion and autosuggestion, and swallowing, breathing, and injecting foreign substances into the body.

Like other forms of play, trances and visionary experiences have often been regarded, sought, and put to human use as religious experiences. Long-lived religious cults have been based upon a single transcendent vision or revelation, and seers, prophets, shamans, and mystics have put states of transcendence to social use. The tendency to identify these states

with religion is ancient, worldwide, and alive today. Some modern supporters of the use of hallucinatory drugs hold that the essence of religion is ecstasy, and that for many Americans ecstasy is possible only through the use of hallucinogenic drugs.

Societies in which ecstatic states and the use of drugs were anciently established have developed customs for their control. The religious ecstatic is taught techniques of control by experienced professionals so that he may begin and put an end to ecstasy at will.

The world capital of the use of hallucinogenic and other sense-deranging drugs in aboriginal times was probably northern South America. Among the Indian tribes of the area, the pharmacopoeia of plant substances inducing remarkable psychic states was astounding and, perhaps fortunately, is still largely unknown in the United States except to a few scholars and scientists. Use of these drugs was regarded by South American Indians as a religious experience and was customary in certain rites. For the average person, use was only occasional and was controlled by convention.

Marcia Keegan

American Indian members of the legally chartered Native American Church of the United States have for decades similarly sought transcendence as a religious act during weekly ceremonies. This is done by drinking infusions of peyote or by eating the fresh peyote plant, a small, spineless cactus containing the alkaloid mescaline. This custom appears to have brought neither addiction nor social disturbance.

In modern India, the drinking of liquid concoctions of marijuana is also religious, a part of the traditional festival of Holi, and is thus similarly permitted and controlled by convention.

Circumstances surrounding today's use of psychedelic drugs by a sizable group in the United States differ outstandingly in a number of ways. As with many other forms of play, the use of drugs is a moral issue intimately tied to our religious tradition. An attitude of disapproval is generally held by even nonreligious members of the population. Prohibited by law, the use of drugs in the United States lacks peaceful modes of control and its regulation is left to the force of law.

Much of the above illustrates that in play, as well as in other things, the whole world is not like Dubuque, Iowa, or New York City, and that America's transition to modern civilization has brought losses as well as gains. But the intent is to say still more—that human play is a suitable subject for scientific investigation, both for its own sake and for the practical value that knowledge of the subject will give.

Play is universal human behavior. It is therefore presumably vital to human existence. Societies regard and handle play differently. Some provide it a place of honor and put it to social use. Other societies, notably our own in recent centuries, have held play in dishonor, a course of action that has borne positive results in monumental economic achievements but that, at the same time, has presented us with a train of social problems.

A much more impressive case than I have set forth in these few pages may be made for the positive aspects of play: its role as a source of important inventions and esthetic creations, as a means whereby children learn adult roles, as a socially acceptable way of expressing hostile feelings and resolving conflicts, as a sanction for behavior. And its importance in still other ways, some of which we can as yet see only hazily.

Man has used play for his own ends; it has contributed to the growth of civilization. Like sexual drives, appetites for food, and other innate impulses, the human proclivity to play requires both recognition and suitable cultural encouragement and control.

Children at Play

If the games of children forecast the future, why are American children rejecting the product-oriented play of their parents and turning to fantasy?

by Brian Sutton-Smith
Teachers College
Columbia University

Our civilization has not paid much rational attention to play. Rather, we have considered it to be irrational, trivial, ephemeral–not really critical. The seventeenth-century creation of an "innocent" childhood has led us, until recently, to consider play unimportant in adult existence. Although in the past fifty years some intuitive investigators have sought to rescue something from this pejorative definition by saying that play is a child's work, little has been accomplished in the systematic understanding of play.

The Genevan psychologist Jean Piaget demonstrated that much of what we had called play is really the activity of intelligence. From the very first days of life, the child is learning discriminations and forms of effective behavior. A generation of American psychologists showed that much of the time a child is intently "exploring" his world and that we should not call that play either.

What then is play? To answer this question we need to say something about the special feelings, the special volitions, and the special structure of play. Entering into play seems to involve a relaxation of feelings. A baby who has had his bottle and is "playfully" sucking and tonguing in his mouth has a quiescent, euphoric, ruminative quality. Paradoxically, once play gets under way, new forms of feeling and tension often rise. For example, a championship chess player was recently quoted as saying, "For the most part chess is everything. It's a tight world of 64 squares. It's an unreal fascination. You're always thinking. You're always in the present time. You know you're alive. You're always being challenged and threatened."

Marcia Keegan

Perhaps play has a temporal sequence: first, a relaxation of customary feelings; then the induction of new, play-appropriate tensions, followed by relaxation at the end. The "pleasure" of play has a distinctive alternation between relaxed and heightened affect.

Play and game involvement are customarily voluntary. The player begins because he wants to, and once in the play he makes his own choices and behaves in the novel ways he wishes. The player has more freedom and can sustain his chosen activity without interference for considerable periods. Being active rather than passive before fate may account for the immediately euphoric quality of play, while the exigencies of the new game may account for the novel tensions that then arise.

These considerations lead us to define play briefly as a transformation of feelings, volitions, and thoughts for the sake of the excitements of the novel affective, cognitive, and behavioral variations that then occur. In play the ends are indeed subordinated; the means justify the ends. Within this context, play of children can be usefully divided into four categories: imitative, exploratory, testing, and model building.

Imitative Play

In the first year of life, the earliest forms of imitative play usually involve the child imitating the parent imitating the child. The baby can only do well what he has already done. The mother who imitates the six-month-old baby's sucking sound may then induce the baby to reproduce that same sound. The difference between the original sucking and the new sucking noise causes them both to laugh during this game. By the end of the first year a number of mother-child games (for example, handclapping) have this circular imitative basis.

By the second year the infant can imitate other people by himself. This deferred imitation is illustrated when the 18-month-old child "pretends" to rub the face cloth all over his face as if washing, although he is nowhere near the washbasin. If he does this washing at the basin, we might say that it is intelligent imitation, a mode of knowing. If he does it nowhere near its proper setting, we can say it is imitative play. In this second year of life most of the imitative play will be partial acts borrowed from sleeping, eating, and washing.

In the third year, children show a greater awareness of their own pretense and tend to copy other people as a whole. They become mothers and fathers. The imitation of whole people can be difficult in some modern societies where the father's work is outside the child's sphere. For example, in a suburban nursery school, children did not like to be assigned the role of "father" in their dramatic play. Most of them refused. One boy, who reluctantly took the part, rapidly rode his tricycle (car) away from the "house," turned around at the end of the room, tore back, clasped "mother" in his arms and gave her a loud kiss, stretched, and said, "Well, I guess I'll take a nap."

In most of this early imitative play the child imitates the important and powerful people in his life. In homes or in cultures where the parents are highly authoritarian and inflexible, play throughout early childhood is usually rigidly imitative. Alternatively, in cultures where adults have much greater flexibility in their roles as adults and in their adult–child relationships, at about the fourth year the characters in children's play become increasingly imaginary and less faithful copies of rigid parental prototypes. Cross-cultural information suggests that the rigid imitation of parental power has been the rule throughout most of human history, and that the rather imaginative play we have come to observe in modern nursery schools is a late product in cultural development.

Morton Tadder

Similarly, toys may reflect the children's needs for exact replication of overpowerful superiors or for more flexible venture into novel worlds. The social play of the fourth year also reflects these differences. In the more rigid tradition the play involves a dominant child forcing the less powerful children into inferior roles. The dominant child arbitrarily fixes the parts the other children shall play and refuses to reverse the roles. This order of events is then maintained by threats and bribes. In modern nursery schools there is more readiness to take turns and to alternate the desirable roles.

Between four and six, imitative social play tends to be governed by one player acting as a central person and the others acting in satellite roles, or by players taking turns and alternating the roles, or by all the players doing much the same thing at the same time.

In earlier times in America this age group performed a number of circular group-singing and rhythmic pastimes that emphasized choral imitative behavior. These circle pastimes are still found in some nursery schools and in certain rural or immigrant environments. Many were simple group pantomimes such as "ring-around-a-rosy," "baloo, baloo, balight," "looby loo," "mulberry bush," but most were choral celebrations of marriage or funeral customs, such as "Poor Alice is a-weeping," "Sally Waters," "Knights of Spain," "Green Grow the Rushes, Oh," "Green Gravels," and others.

Today we see less of these traditional pastimes, and more informal, imitative group games known by such names as "houses," "cars," "trucks," and "schools." These latter games have seldom been studied systematically, perhaps because they are found in homes and neighborhoods more often than in the more accessible school playgrounds. Whatever the reason, the meaning behind these games probably could give us a better indication of how our civilization is going than anything else that children have to tell us.

Exploratory Play

It is difficult to separate exploratory play from exploration. When a child discovers a novel object and examines it, he is not playing. But what if the novel object is a toy that the child is examining in his usual play milieu? Is that play? Because the answer lies in the child's attitude at the time, it is difficult to provide an answer, particularly for the first two years of life when play consciousness is not clearly differentiated.

Still, even in the first six months the child occasionally seems relaxed and pleased when he plays with his tongue and lips or his hands and fingers. This might well be exploratory play. And in the second six months, play with the parents' face and hair

Marcia Keegan

is often accompanied by smiling and laughter. In the second year, exploratory activities that may well give rise to exploratory play include tasting, scribbling, emptying, filling, inserting, putting in and out, pulling, stacking, rolling, and climbing into and under small spaces.

By the third year this exploration grows increasingly complex. Various patterns of organization become manifest. The child arranges, heaps, combines, transfers, sorts, and spreads. The child is also aware that he is playing and that his objects are toys. He piles the blocks in new and amusing ways. Novel manipulations and effects excite him. Much so-called destructive block play has this character. Towers of blocks make marvelous effects as they crash to the ground or get higher and higher before falling. Blocks do odd things when a child pushes one against another, then another against the first one, and then another and another. Clay can be pushed and squeezed and torn into pieces that yield funny shapes and feel different to his fingers. Sand pours from buckets and over his legs in pleasant ways. There are again novel feelings, novel effects, and novel relationships in a familiar setting.

At the same age level, from three to four years, we should not neglect the extensive verbal exploratory play that children exhibit. They put words and sounds together in novel combinations, most frequently while sitting in bed early in the morning or before sleep at night.

In childhood today, exploratory play is facilitated by innumerable toy models—cars, ships, and skeletons. These models partly confine play, but children often build fantasies during their examination and construction of the toys. Verbal exploratory play is also conventionalized in childhood through prescribed humor and nonsense. Riddles expose the child to novel contingencies in semantic relationships: "Why did the dog get out of the sun? He didn't want to be a hot dog." Nonsense yields absurd possibilities: "I took a chair and sat down on the floor."

Testing Play

In many types of play and playful contests, the child is testing himself. During his second year, he does a great deal of large motor testing. He crawls under and into things, pulls wagons, lifts objects, pushes, hammers, splashes, rides, balances, climbs, digs, opens, closes, runs, throws. Much of this is not play, but direct testing and adaptation in a given situation. At times however, an exuberance to the pulling, the pushing, the creeping into cupboards makes it play. Testing play is a form of self-validation.

As the child becomes older, the tests he enjoys increase in variety and character. The baby climbing the stairs gives way to the child jumping down them three at a time or sliding down the bannister. The most obvious way in which testing takes place in play is in the social form of games. In these games the child obtains his self-validation by using others as his standard of competence. He seeks out competitors with talents matching his own. Against them he can measure his progress.

Most testing games are contests that deal with some of the major forms of emotional life. There are games of approach and avoidance, incorporating the behaviors of withdrawal and escape (hide-and-seek), in which the emotion of fear and the adaptive function of protection are tested out. There are games of attack, in which anger and the adaptive function of destruction are tested (dodge ball). There are games of choice, in which joy or sadness, mating or deprivation are tested (flashlight kissing); games of observation in which expectancy, sensory functions, and exploration are exercised (memory), games of impulse-control, in which surprise, stopping, and orientation are critical (priest of the parish).

Each of these types of contests can be arranged in a developmental sequence that children go through between the ages of five to twelve years. This development can be illustrated through four levels of approach and avoidance games. At each level in the game there are particular spatial and temporal relationships, different approach and avoidance actions, and special relationships between the players.

Level I (hide-and-seek, tag). First played extensively between five and six years, these games continue for many years, particularly in the play of girls

There is one central person (the *It*) who has most of the power (he can select whom to chase, when to run) and a number of other fugitive persons who try to hide or escape by holding on to a safe base or saying some safe term. The players' actions are reversible. The space is differentiated into "hiding places," or "safe" spaces, and dangerous territory. These two qualities of space (security versus danger) may be analogous to the division of religious and mythic spaces into the sacred and the profane. The temporal arrangement is episodic. Each incident is of equal weight, and one follows the other interminably. When the *It* tags another player, he is replaced by that player and the game continues.

Level II (release and ring-a-lievo). In these games, which become popular at seven to eight years, a central *It* figure again attempts to capture the other players. But now these other players can harass him and rescue each other. While the *It* is accumulating the captured at his base, all the captured players can be freed if one of the free players rushes through that base and cries "release." As well as "hideaways," there is now a "captive base." Space has been differentiated into these two special types of territory. Time has also changed. It is now cumulative. Each episode adds to the previous one until the *It* catches all players and is then relieved of his role.

Level III (red rover). In this game, which is popular among nine- and ten-year-olds, the *It* player calls the others across from one base to the next. As they race from base to base he attempts to catch them. If he succeeds, the captured player joins him in the middle and helps him catch the other players. The play takes place now within defined boundaries, with two safe bases at each end. At some middle point, the play resembles a team game with half the players on each side. The play reaches an exciting climax when everyone except the last player has been caught. He is the fastest, the most cunning of all, and all the other players join to capture him. The game has a crescendo effect, and the exciting capture of that last player is a climax time.

Level IV (prisoners' base). In a complex game usually played first at 11 or 12 years of age, two relatively undifferentiated teams pursue each other over a large, but defined, territory. The pursued players attempt to return to base before they can be hunted down. There are home bases and prisoners' bases and one team attempts to eliminate the other. When this is done, the game is over.

In these four levels of play, the child first tests his powers against "magical" *It* figures, and finally, at an older age, against other players of relatively the same skill. The actions in this sequence evolve from chasing and escaping to capturing and rescuing, with the final game of prisoners' base containing both sets of elements. Each level has a new form of spatial and temporal arrangement, which corresponds to parallel forms of cognitive organization in children of these age levels. But the spatial and temporal qualities take on a vividness in games that they may not have in other situations. Notions like episodic, cumulative, and climax time are also illustrated in the picaresque stories, folktales, and dramas for children. Some cross-cultural data show that games of chase, escape, capture, and rescue exist in cultures where children are made anxious about independence. The children's running back and forth between bases may represent attempts to come to terms with their apprehensions about becoming independent as against remaining dependent. In these games they test their ability to hide, to escape, to capture, to rescue without becoming overwhelmed by fear.

Similar levels can be illustrated for the other types of games. The relationships between the levels in games seem to be additive. Rather than disappearing, the younger elements are added to the next level of games. A sport of adults, such as football, may include many elements of child play.

When game progress is viewed in this developmental fashion, it seems clear that as children proceed through the series, they gain an understanding of social relations, social actions, space, and time.

Model-building Play

Although difficult to observe in the very young, model-building play becomes explicit by about four years when the organization of houses, tea parties, blocks, cities, trucks reaches a peak. It becomes a different type of play when the child puts elements of his experience together in unique ways, especially when these involve flights of his imagination. During childhood, play with model worlds of trains, dolls, and cars may be facilitated by commercial toys. This is the play that the psychoanalyst Erik Erikson has suggested is the analog of the adults' "planning" activity. There is a widespread, but unsubstantiated, belief among many adults that because children today have so many toys and models they spend less of their time in these solitary constructive pursuits. Actually the problem may lie less with the toys than with the parents' inability to provide examples of creative adult activities.

In today's society (as indicated by movies and television), fantasies about novel human interrelationships are a key form of model building. The industrious, product-oriented play that we of an older generation encourage in our children is more related to nineteenth-century industrialism than to tomorrow's customers. I have been impressed at the speed with which today's children construct gregarious fantasies with humor and versatility in their informal play. Here is another fitting area for research into the future of our own society.

A great deal of systematic observational work, probably with video tapes, will be necessary before we can decide what we mean when we say a child is at play. I am certain, however, that most readers will be unsatisfied with this state of affairs. They will want to know what play does. Why is it so important to define it? Unfortunately, answers to this sort of question must be even more imprecise than the missing observations.

From the analysis of play in animals we know that play increases as we ascend the phylogenetic order. The more complex the animal, the more it plays. From cross-cultural studies we know also that as culture becomes more complex, more types of games are added; and that different types of games are systematically related to other cultural variables. For example, games of strategy appear in cultures when diplomacy, class stratification, and warfare are institutionalized. Games of chance appear when survival conditions are uncertain. Studies of devoted game players in our own culture show that they have distinctive attributes that go along with their game playing. The players seem to be molded by their games, they don't just "play" them.

Such general discoveries indicate that play and games are functional in culture. Just what this functionality is, however, is another question. I suspect that the primary function of play is the enjoyment of a commitment to one's own experience. In play, the player makes the choices. In modern society, where individuals are increasingly aware of their alienation, such a commitment may have considerable survival value.

Once the player begins the game, the uniqueness, nonsense, triviality, distortion, or serendipity that follows may well bring secondary gains. The experience of play heightens the player's flexibility and imaginative capacity in addition to improving his physical and strategic competence. But these secondary gains are clearly indirect.

Games are in part imitative of the larger culture and therefore embody its processes and attitudes. But because play is voluntary, it admits madness as well as sanity. So that what ensues may be only partly a rehearsal for any specific cultural outcome. The primary purpose of play has a deeper importance for every individual. Playing children are motivated primarily to enjoy living. This is the major rehearsal value of play and games, for without the ability to enjoy life, the long years of adulthood can be dull and wearisome.

Morton Tadder

At Play in African Village

Some of the immense problems of learning may be solved if educators turn to play, rather than to Plato

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What we call children's play is in great part the consciously patterned ways in which children relate to, and experiment with, their social and physical environment and their own abilities. Therefore, theorists of progressive education have continually stressed that free and "playful" manipulation of their environment is important for children's learning.

In preindustrial society, as children grew to adulthood, play merged with work, and formal instruction supplemented what children were already learning through direct observation and experimentation. However, industrialization separated productive work from the flow of family and community life. "Play" became sharply differentiated from "work," and an ever increasing period of formal schooling preceded participation in adult occupations. Only under such harsh conditions as child labor in factories did children still learn by observing and doing.

The role of play in learning is of special relevance for the nations of Africa, which, following political independence, have made major commitments to achieving free public education for all children. African leaders are caught between the goal of striving for a life-style established by affluent European colonialists and the goal of independently resolving as Africans the problems of urban industrial society. On the one hand, they are building educational institutions in keeping with conservative Western models, while on the other, they are strongly committed to Africanizing their curricula and to finding more effective ways of preparing all children for meaningful participation in African society. In this context I shall consider children's play in Zambia and its potential for curriculum planning.

Zambia lies north of the Zambezi River in the high interior region of southern Africa. Zambians are among the many Bantu-speaking peoples of eastern and southern Africa who traditionally lived by a combination of cattle raising and agriculture. Urban trading and political centers have risen and fallen over the centuries in eastern Africa. However, the people of Zambia have always been overwhelmingly rural, living in villages or networks of dispersed family compounds. This is still true despite the rapid growth of the cities on the Copperbelt and of the capital city, Lusaka. In spite of the great changes that followed European incursions into Africa, many qualities of a preindustrial, self-sufficient agricultural and cattle-raising economy have persisted.

As in preindustrial societies around the world, imitative play was basic in the training of African children. It has been described by many scholars, including Jomo Kenyatta, who writes that in their play, the Gikuyu children of Kenya "do most things in imitation of their elders and illustrate in a striking way the theory that play is anticipatory of adult life. Their games are, in fact, nothing more or less than a rehearsal prior to the performance of the activities which are the serious business of all members of the Gikuyu tribe."

"Playing house" is a rehearsal for adult roles by children around the world. In African societies it entails technical as well as social practice, for boys and girls build and thatch small houses and make and use various tools and utensils according to local practice. The boys make axes, knobkerries, spears, shields, slings, and bows and arrows, and may also build miniature cattle kraals. Girls make pottery for cooking real or imaginary food, clay or reed dolls, and perhaps mats or baskets of plaited grass.

Play is smoothly and informally transformed into work. May Edel writes of the Chiga of Uganda:

> A little girl accompanying her mother to the fields practices swinging a hoe and learns to pull weeds or pick greens while playing about. She learns the work rhythms, the cycle of the seasons, which crops must be planted in "hard" fields, and how to tell whether a field is "soft" and useful for certain crops or ready to lie fallow. A boy tagging after his father watches him milk the cows or thatch the house, whittle a hoe handle or roast a bit of meat on a stick. Playing with a small gourd, a child learns to balance it on his head, and is applauded when he goes to the watering-place with the other

Cherry Lowman Vavda

> children and brings it back with a little water in it. As he learns, he carries an increasing load, and gradually the play activity turns into a general contribution to the household water supply.

Kenyatta writes that as Gikuyu boys help in the fields, their fathers teach them the names and uses of various plants. From his own childhood experience, he recounts how the Gikuyu boy roams the countryside and "learns to distinguish a great variety of birds, animals, insects, trees, grasses, fruits and flowers. His interests bring him in contact with these things, since they constitute the furnishings of his play activities."

Riddles and puzzles are asked of young children in the evenings, either by their mothers or by older children. Kenyatta speaks of these as "mental exercises." In addition to learning about manners and mores through direct instruction, young people learn about their people's history and society through lullabies and stories. As soon as they are old enough to remain quiet, they are able to listen to the adjudications that take place in the outdoor courts, and to the lengthy discussions of community affairs by the elders. Through these means, too, children are introduced to the highly valued rhetorical arts. Margaret Read recounts that in Malawi,

> a perennial amusement among Ngoni boys of five to seven was playing at law courts. They sat around in traditional style with a "chief" and his elders facing the court, the plaintiffs and defendants presenting their case, and the counselors conducting proceedings and cross-examining witnesses. In their high, squeaky voices the little boys imitated their fathers whom they had seen in the courts, and they gave judgments, imposing heavy penalties, and keeping order in the court with ferocious severity.

As children assume adult roles in the course of play, they are praised and applauded, but they set their own pace and determine their own special interests. When they want to learn something, they set about learning by observation. There is considerable individual variation, therefore, as to when children learn things and what they choose to learn. Specialists—smiths, woodcarvers, beekeepers, tanners, shield-makers, barkcloth-makers—teach their sons their crafts, but even here there is wide latitude for individual interests.

The time comes when the freedom and casualness of play and exploration are replaced by expectations of mature performance. The older herdboys are held responsible for keeping the cattle healthy and well-fed. Kenyatta describes how young herdboys are tested to see that they know each individual of as many as a hundred cattle, sheep, and goats. The boys must sort out herds that have been mixed. The ceremonial initiation into adult status that takes place at about the time of puberty is marked by formal teaching and testing about religious and social matters and adult codes for behavior. Demands for competence, however, are based on many years of free and experimental participation and experience.

By contrast, mission schools introduced a type of education that minimized direct observation and experimentation. Learning was by rote; the question raising and problem solving that were part of informal participation and play were absent. So, too, was the direct experience of the apprentice. Kenyatta writes:

> Whereas European schools in Africa provide training in nature study, woodwork, animal husbandry,

Pamela Meyer

etc., much of which is taught by general class instruction, the tribal method is to teach the names of particular plants, the use of different trees, or the management of a particular herd of sheep and goats or cattle. After this the child is left free to develop his own initiative by experiments and through trial and error to acquire proficiency.

The authoritarian character of mission education (like that of colonial or semicolonial areas around the world) persists in independent Africa. When observing primary schools in Zambia, I was impressed by the strong motivation of the children and their parents, and by the ability and dedication of teachers who were working without the benefit of much training. Yet the atmosphere was restricted by an over-all emphasis on education as acquiring the ability to speak, read, and write English, to handle figures, and to remember a set body of factual information that was to be imparted by rote from the teacher to the children.

While the importance of manipulation, experimentation, problem solving and question raising—based on children's direct experiences—is being accorded widespread recognition in the West, African education is still obstructed by outmoded authoritarian European patterns. As the first step out of this situation, there has been an attempt to overhaul the curriculum thoroughly; to introduce African history and institutions, names, foods, climate, and countryside into the readers and texts. In Zambia, the country with which I am most familiar, the next step in curriculum planning for the primary school has been to promote more teacher–student interchange and to introduce problem-solving devices such as dot-cards in mathematics.

A further step, then, would be to work out more fully how the children's education can be more directly built on their day-to-day experiences as they organize themselves for a variety of games and activities: count scores; handle volume, area, and linear measurement in myriad ways; engage in adult role playing; work with language, story, and song; apply practical knowledge and technical skill in the making and use of varied toys and instruments; go to the local store for their families; or help about the house and kitchen garden.

It was easy to observe children's activities from the house where I lived in Matero, a large working-class suburb of Lusaka. Its yard was a local playground, and an empty field lay between it and one of the neighborhood primary schools. Their activities were also reported on by the many children interviewed and described in detail by my research assistants.

Most commonly observed was the popular boy's sport soccer. Boys may form themselves into teams, raise funds for a ball and team shirts by doing odd jobs or soliciting money from relatives, elect a captain and administrative committee, and set up rules. In one case members were to be fined 20 ngwee (28¢) for being absent from practice without excuse. Endless variations on other ball games were also observed, as well as local variants of worldwide children's amusements: hide-and-seek, tag, hopscotch, tug-of-war, jump rope.

Boys and girls characteristically have their own games and play separately. A common girl's game involves throwing a ball back and forth between two lines of players, trying to hit a girl in the center before she can fill a bottle with dirt.

From the age of six on, children play the "husband and wife game," for which they build and thatch playhouses and make clay utensils. A girl of nine told of staying away all day and cooking real beans and nsima, the staple food of stiffly boiled cornmeal. Usually the girls play separately, but a boy spoke of making sun-dried bricks, using a wooden mold, for building a playhouse. Both sexes make clay cattle and other objects: the girls, often dolls and utensils; the boys, cars.

They also rummage in garbage bins for tin cans. A boy described how he and his friends stacked them up as high as they could before they fell. Little girls play filling them and pouring water and dirt back and forth. Watching their concentration, one is reminded of statements such as the following from a manual of the Nuffield Mathematics Project, so influential in the current changes in the British "infant schools": "From the point of view of mathematical concepts water play is important in establishing a basis of experience which will lead to the eventual and true understanding of volume and capacity. The children will be filling three-dimensional space and discovering relationships between containers."

Old hunting games are not completely gone. Children set fire to dry grass in the fields to catch rats; make slings for shooting birds; and trap them with *ulibo*, a plant gum, which they collect, heat with oil, and knead. The city of Lusaka is spread out, and there is some open space for gardening. Children may help clear and work the ground. Some boys help their fathers with carpentry or brick making. Girls often report enjoying helping their mothers cook, sometimes giving recipes. And again, the Nuffield teaching manual points out: "Experience of volume, capacity, weighing, estimation, measurement of time; the appreciation of the approximate nature of measurement; and the need for standard units—all these may be derived from cooking activities."

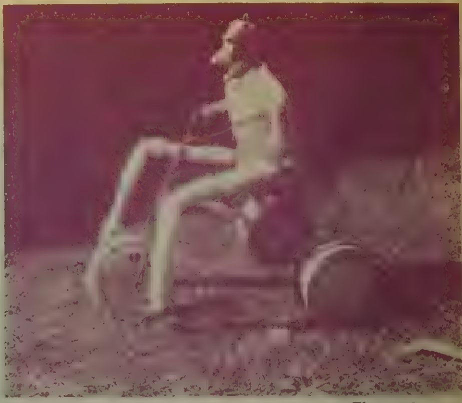
Boys scrounge for the materials to make musical instruments—oil tins, pieces of rubber or plastic, light wires. They make banjos and guitars, drums, and bass fiddles consisting of a single heavy string attached to a drum. They often write their own songs and organize bands, hoping to collect a little money performing at informal gatherings. One day a local band led a "parade" into the yard and around to the back of the house. More than fifty smaller children followed, showing the casually self-imposed orderliness that characterizes such situations.

Girls love *chitelele*, the traditional women's dance in which women step out of a singing, clapping circle to take turns dancing individually in the center. Girls know a great many *chitelele* songs; in fact, both sexes know an endless number of songs, both old and new, and love *mashasha*, or dancing as couples to jazz. They also know folktales, which the older tell the younger; while living in a village for a period, I collected some of these from children nine to fifteen years old.

The mélange of languages spoken in Lusaka (as in African cities generally) is great, and the children are adept at hearing, interpreting, and compensating for dialectic differences in closely related languages. Indeed, their linguistic facility and interest is so great that it suggests an area for curriculum development to enrich the cognitive content of English teaching. This verbal sophistication is illustrated by a game called *kapenta* (a fish, dried for shipment), as described to me by a twelve-year-old girl:

> In this game, people sell *kapenta*. One person in the game is Nsenga and the other Bemba [two of the many national groups in Zambia]. The Bemba sells the *kapenta*, saying, "I am selling *kapenta.*" The Nsenga asks the Bemba what he is selling in Nsenga. The Bemba misunderstands, and a fight starts due to the misunderstanding of the languages. Someone who knows both languages comes to intervene in a fight between the two and explains what each one has said to the other.

Boys are ingenious at finding and making do with available materials. Seesaws are improvised; poles found for stilts and pole vaulting. To make a wagon, one boy says he gets planks from a brewery, finds floor-polish tins, cuts poles from trees, and makes wooden wheels. Another boy of ten recounts difficulties making wagons:


Eleanor Leacock

> It is difficult to obtain the wheels, because sometimes it is risky. I went to a construction site to look for wheelbarrows to take the wheels out. After I collected the wheels, I got a wide plank and two iron bars, to which I fixed the four wheels. I tied the axles to the plank with wires, and made a steering wheel. Friends pushed me, and one day we went to Lilanda where the traffic policeman caught us and took the car away from us.

The most characteristic of African toys is the wire car. These are models of cars and trucks that most boys start making at eight or nine. They are from one to two feet long, and made of heavy wires bent into shape and bound together with finer ones. Discarded wire is found without too much difficulty or if pilfered, becomes anonymous when reshaped. Sometimes the models are covered with pieces of packing-case cardboard. An eleven year old says:

> I collect the wires from the rubbish pit at Mtonyo Township whenever the municipal vehicles go to dump some rubbish. After I have collected the wires, I take some of the biggest and make the chassis of a bus. Then I build up the body. When the body is done, I take some cardboard and attach it to the bus to make it look more like the usual buses we board.

An unusual style is made by another eleven year old, who attaches a clothed wire person to a Honda, actually a tricycle. "When I start driving," he says, "it begins dancing," describing one which wobbled from side to side when pushed. He sells them, he says, at 24 ngwee each (34¢). A nine year old says:

> The cars I like very much to design are Fiats and Land Rovers. I ask my friends who live near the municipal rubbish pits to collect wires for me, which I buy at 20 ngwee. When I make the cars, I drive them in the road, but when I am fed up with one, I sell it for 40n to a friend who doesn't know how to make them.

(The price quoted was perhaps high; it had been bruited about that I was in the market for wire cars!)

Most models are uncovered trucks, which can be loaded with miniature logs. A twelve year old says that when he makes a car he gets together with his friends. "We make small roads and put up road signs and signals, and one of us becomes the traffic inspector. Anyone who commits a traffic offense is charged and is liable to a fine of four buttons."

Boys are most commonly seen running up and down with their cars, pushing them along from a standing position. A long heavy wire, bent into a circle at the driving end, is attached at the other end to the front axle of the car in such a fashion that the boy steers the car by turning the wheel in his hands. One of several steering mechanisms may be employed. After a boy decides which type of car or truck to build, he straightens and cuts lengths of heavy and light wire. The chassis is built first, and from this the proportions of the sides assessed. The model may be purely exterior or finishing touches—a front seat, driver, and steering wheel—may be added. No tools are used; none but hammerstones are available. Stove- or shoe-polish tins are usually used for wheels, enclosing wire circles stemming from the axles.

Discussions I had with educators David Simmons and Delpha Keys defined the many ways in which the management of proportions, spatial relationships, symmetry, and measurement involved in the building of these cars can afford a basis for exploratory classroom discussion. Not that individual cars lend themselves to effective use; they are too complex. However, wire models of just chassis and wheels, familiar and often of interest to girls as well as boys, could be used to raise such questions as: How much wire would be needed for a chassis of the same proportions, but twice as long? How much more material would be needed to cover it? Children could make wire cubes and find out how much wire is needed for a cube twice as big; how much cardboard to cover it; how much gravel to fill it. Or the children could explore the relationship between wheel size and the number of rotations a wheel makes in a meter. Or, a problem suggested by the Honda-maker, who uses a split back axle on his tricycle: What happens to each back wheel when a car with a solid back axle is turned? With a split back axle? Why?

Other games played by Matero children are variations on marbles and jacks, played with stones. Board games of various sorts are known; checkers is a favorite. Most interesting, however, is a characteristically African game, *nsoro*. A West African version is played on a thick board with carved-out hollows into which counters are placed. In Zambia, long rows of holes are simply scooped out on the ground, and pebbles are collected for playing. In certain neighborhoods, groups of men can almost always be found standing over a game of *nsoro*.

A simplified children's version of *nsoro* is played using four parallel rows of 12 holes each. There are two players; each has two rows to move in. The game starts with two stones, or counters, placed in each hole of the two outer rows. Counters are moved to the right in the outer rows; to the left along the inner rows. When a player lands in an inner hole adjacent to an opponent's inner hole containing counters, both these and any in the corresponding hole on the outside row are "eaten," or knocked out of the game. The winner is the first to eat all his opponent's counters. A move consists of picking up all the stones in a hole of one's choosing, reserving one of these, and placing the others one by one in successive holes. If the next hole is empty after they are played, the reserved stone is placed in it and the move is finished. If not, all stones in that hole must be picked up and played as part of the same move, which cannot end until an empty hole is reached for the reserved counter. As a player moves into the inner strip, close to his opponent's counters, he must be careful not to leave himself open to being eaten without at least being in a position to eat more of his opponent's counters in return.

In playing *nsoro*, then, children learn to weigh alternatives that involve a series of additions and subtractions of small numbers. The entire strategy of a play is complicated, but elements of the game—an enjoyable activity in which younger children watch older ones, and older children watch the more complex adult version—could be utilized for presenting concepts of number, and addition and subtraction. To quote again from the Nuffield teaching manuals, "Many teachers have realized through their own experience that *more* learning and indeed more enjoyable learning can be gained by working through the interests of children and many of these interests do, in fact, arise during play."

At Play in the Fields

"The juvenile patas monkey jumping up and down in the tall grass may seem to be enjoying a nice sport, but the full importance of these motor patterns is not obvious until you see an adult male patas jumping to divert the attention of a lion from the rest of the group"

by Phyllis Dolhinow

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If the hours a young monkey spends each day in play are any indication, then play must be a major category of primate behavior. This conclusion is underscored by the complexity of play and by the amount of energy a young monkey devotes to it.

Play is probably important in the development of all mammals, but it appears to be particularly important for the slow-maturing monkeys and apes. Juvenile monkeys play for years, investing thousands of hours of activity, energy, and emotion. Such an expenditure of biological resources must serve important biological functions. The theory of natural selection compels us to look for the adaptive reasons for this behavior.

Perhaps in part because of the values of our culture, play has not been considered a major research problem. Field studies have relegated play to one of a long list of kinds of behavior. To appreciate the subtleties of its performance and to attempt to understand the nuances of its functions, play must be evaluated in the natural setting of the species, rather than in a laboratory.

For most primates the context of normal life is a social group—in all its complexity and stability. This group is a small world with few intrusive events. A majority of monkeys live their entire life in the group of their birth; hence they know it and its location well. This is the setting of play: a rich blend of social relationships and ecological pressures, dangers, times of plenty and scarcity, and seasonal changes in both environment and group. Play behavior is characteristic primarily of large infants and juvenile monkeys, although adults may play on rare occasions. This fits in with the notion that play is preparation for adult life, that it is of major importance in the learning process. In contrast to adult activities, play is its own reward. Play does not lead to the attainment of some other goal, such as food. The playing juvenile uses the same kinds of behaviors as the adult, but often in odd sequences or combinations. Play fighting may be aggressive, but it still includes actions that would be suicidal in a serious encounter. Little monkeys make great efforts to play: they go to other juveniles, initiate games, and stimulate each other. In this sense, play comes from within, it can be pleasurable, and its actions are repeated over and over again, year after year.

Superficially, play may seem simple. There is chasing, wrestling, and boxing. But closer inspection shows that the actions are not simple. If it is an important part of the education of a species and if many adult behaviors are practiced in games, then we should expect to find great variety behind the apparent simplicity of play. This is, in fact, the case.

When a large number of monkeys play, there are rapid alternations of participants, actions, and individual moods, which all produce variations of activity. Some motor patterns appear regularly. A group of playing rhesus monkeys may, in a few minutes, push, pull (hair, fingers, limbs, ears, tails), spin, squint, drag feet, rub with hands, scratch with nails, run, jump, chase, fall down, charge, swing by the feet, lean, mouth, and shove. The list usually also contains gestures of threat and submission. When threats appear, tension may develop, turning play into aggression.

The intensity of play can be measured only imprecisely. The human observer cannot use the frequency of cries as an index of pain; cries may reflect the mother's closeness and willingness to back up her infant more than it reflects how much the infant is hurt. Social context can affect play in ways that are not obvious. An animal may ignore pain in play if the intentions of the inflicter are nonaggressive, whereas in other interactions a bite or slap of the same intensity will produce a severe reaction. The sound of heads banging on tree limbs or on hard ground in play makes the human observer wince, but often appears not to deter the monkey whose head was banged. Instead, he sits for a moment, then jumps back into the fray.

Subtle glances, tensing of muscles, pressure of grasp, severity of nipping are but a few of the many cues that are not available to the human observer, who is aware of only a small portion of what the players experience.

Consider the following examples of play, which I have observed among wild primates:

1. In a village in northern India, a group of four large and two small juvenile langurs were playing on top of an abandoned irrigation well. The two largest sat face to face boxing each other's shoulders. Next to and touching them was another pair of juveniles, wrestling in a ball. All four were bumped by the smaller juveniles who ran around and over the well in a wild game of chase and reverse chase. From time to time individuals would pause, look around them, and flop to the wall or ground for a few seconds, as though gathering strength for another onslaught of wrestling or boxing. Occasionally, partners changed; and even the smallest langur eventually sparred with the largest, although for a much briefer time than a pair equally matched. Most of the action took place in pairs, and the participation of each langur appeared to be completely voluntary.

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2. In the Singapore botanical gardens, two crab-eating juvenile male macaques were sitting close to one another on a limb. The larger was looking at the smaller, who was quietly regarding his navel. The larger got up, glanced again at the smaller, reached out and poked him with a finger, then quickly sat down in the same spot. The smaller jerked his body away from the larger and looked in the opposite direction. After a second's hesitation the smaller looked toward the larger, who immediately slapped him again. The small monkey jumped four feet back along the branch and the larger immediately followed and grabbed the retreating animal's tail. There was a momentary tug-of-war, which ended with the younger falling from the branch and the larger holding him by the tail in midair. When his tail was released, the smaller fell to the ground. The larger macaque then jumped down and chased the smaller one out of sight. Depending upon how this was recorded, it could be tallied as play or aggression.

3. A small juvenile rhesus monkey was roughhousing with an infant on a forest pathway in northern India. The infant was fairly passive and the juvenile turned him over and over quite roughly, mouthing him all the while. The infant began to make faint "uh-uh-uh" sounds, and the juvenile immediately paused in his handling, glanced around to see which animals were nearby, and then resumed mauling the infant. The infant used the vocalization repeatedly whenever the juvenile appeared to be rougher than the infant could tolerate. Always the response of the juvenile was to cease, look and check the reactions of all nearby adults, and when there were none, to continue.

At one point the juvenile pushed the infant forcefully against a limb and the thud of the impact could be heard for 20 feet. The infant squealed sharply and the juvenile stopped. An adult female sitting nearby moved toward the pair and the juvenile ran off. In this instance the infant was using the vocalization very skillfully to force the juvenile to modulate his play activity. The infant was, in fact, controlling the "play" situation. Whether the activity was in any way pleasurable for the small monkey is questionable; that it was for the larger, seemed apparent.

4. Two small rhesus monkeys were sitting side by side on a rooftop in Lucknow, India, and one reached out and leaned on the other. The leaned-on one moved three feet away and sat down. The first again leaned toward him, this time reaching out and cuffing him lightly on the knee. After the slap the first rhesus bent back to a normal sitting position and looked solemnly at the little monkey he had just slapped. The latter sat quietly and gazed directly ahead, away from the other monkey. The first rhesus repeated the slap, this time with a little more force; still no response, then another slap—each time he leaned forward and then quickly bent back. Finally, he reached out, grabbed a handful of fur, and tugged at it hard enough to pull the skin away in a fold. The solicited monkey grimaced at him and bent as far away from him as he could without standing and moving. The rhesus that had been trying to gain the other's attention then sat quietly and after a minute moved away.

In another, similar instance, where the two monkeys were juveniles, the one who was slapped responded after several approaches with a threat and attempted to bite the slapper. This started a fight that was broken up by a dominant adult male. In a third example, one young monkey tried to solicit play in a similar manner, but in this instance the response of the slapped monkey was to join the first in boisterous wrestling and chasing play for some time.

A special gesture called a "play face" is described for many species and signals the nonaggressive intent of the monkey or ape that wants to play. This is an oversimplification, since a monkey soliciting a play partner signals in many ways. It may roll its head from side to side, close its eyes, move in an uncoordinated, jerky manner, bow or bob up and down, or approach backward. The face is only one element of a complex set of movements that carry the message of intent to interact in a manner we call playful. An invitation to play might be a slap and quick retreat; it might even be a bite or a shove, repeated in different ways. There are many ways to start an interaction, to determine the mood of the desired partner, and to communicate the intention of the solicitor.

Field workers who have observed monkey infants grow to maturity can suggest many benefits that derive from social play, including the practice of a number of social gestures and motor skills. Patterns appear in fragments, hardly recognizable as the stereotyped social signals they will become if they are to be effective signals among group members. These patterns are practiced over and over, in myriad con-

texts and among all the young of the troop. There is a slow but certain increase in the motor skills of each young monkey, from the time it first leaves its mother, stumbling off a few inches to investigate bits of its environment, to the time when it will leave her to play for hours. Although it is unlikely that we would call the very early sensory or motor experimentation play, there is no question about much of the later activity of the older infant.

Motor and social skills are practiced in play, but it has not been demonstrated that play is the context in which these skills are originally stimulated or learned. This distinction must be made if the benefits of playful activity are to be understood. If play is considered a context for consolidating skills, for adding small increments of ability and mastery over motor, manipulatory, and social tasks, then the vast repetition of play patterns makes a great deal of sense. Play is not for solving problems from scratch, unless perhaps they are problems with objects, but it may help once the process of solution has been started.

Repetition is a key descriptive word for play—and repetition is essentially practice. Elements of sexual behavior and dominance gestures appear early in social play, but they appear as fragments and often in no apparent relationship to reproductive or actual dominance contexts until the monkey is much older. Playing animals are involved in a great deal of physical contact and continuous social interaction. The ability to control one's own behavior and the actions of other monkeys becomes very important.

Given the amount of direct interaction—especially physical contact—in play, each monkey soon learns differences in the size, strength, reaction time, and tolerance of each player. Rules of dominance are essentially based on strength and ability to use social signals, and if learning which animals are stronger involves some pain, the young monkey may learn the rules rapidly. For young juveniles, especially males, the opportunity to play dominant, as well as subordinate, roles may be a part of the attractiveness of play. From a broader view, the total experience of play makes ranking possible and seemingly inevitable.

Social cues and complex communication patterns are developed in the relative safety of play. It does not do any good to be the strongest and largest in the group if at the same time most other adults can bluff their way past to a desired object. A monkey must know not only the form and context of each social gesture, it must also be able to execute each with style and finesse. Timing must be perfect, and since most fights are avoided by complex gestures of threat and submission, the monkey that bluffs best probably goes furthest in the long run.

Play is often considered by humans to be pleasurable. Among free-ranging monkeys some play appears to be pleasurable and fun, but much does not. The tensions aroused during play often appear to result in the dissolution of the play group. It is possible that a degree of what we think of as pleasure is obtained from increased competence of movement and skill in the use of signals. We can only guess the motivations of a nonhuman primate; it cannot tell us anything from introspection.

A juvenile male wrestling in the arms of an adult male may appear tense and inhibited in his movements. He may finally utter a squeal of fear and succeed in breaking free from the adult. The latter may have been making a play face toward the younger male the entire time they were in contact, but the gesture did not avert the juvenile's breaking away. What may surprise the observer is the juvenile's immediate return to the adult male; this pattern may be repeated again and again, with the juvenile fleeing each time, only to return for more rough play. The juvenile's ambivalence is apparent; his actions continually shift from approach to withdrawal. Such conflict situations, with their tensions and anxieties, are present in the behavior of monkeys and apes. It remains to be demonstrated whether or not any of them are resolved in play.

An ape may pound on a tree when it cannot pound on another ape that annoyed or frightened it. Whether a young ape destroys a twig in play because

Baboons Harshad Patel

it would like to do the same to a new sibling is a matter of human conjecture. The play group may be a location for working out aggression that the animal might otherwise wish to direct toward larger and stronger individuals. Helplessness for the younger infant monkey relates most clearly to locomotion and anxiety about leaving its mother. As it grows, it will also experience anxiety related to relationships with others.

Much play appears to be testing of one kind or another. Players constantly push to the limits of tolerance of aggressive behavior, especially older male juveniles that are large and strong and able to inflict injury. An aggressive invitation can be followed by avoidance, play, or fighting–depending upon the mood of the solicited, the actions of the solicitor, their past experience, nearby animals, and probably a long list of other factors that are not apparent to the human observer. No wonder the human reports that rough play borders on serious aggression and that it is difficult to know whether to fit these episodes into aggression or play. The apparently ambiguous actions of large immature monkeys doubtless reflect their ambivalent feelings as to whether they will fight, mildly test relative rankings, or tussle and chase in a frankly playful manner.

The immature monkey constantly tests its strength and social skills, its bluffs, evasive abilities, and allies in playful activity. It also tests its environment, but not, at first, in play. Strange surroundings or unusual events appear to inhibit playful activity. New corners of the environment are first investigated; then, and only then, played in. The initial response to strange objects or events is one of great caution.

As a way of testing and gaining small increments of skill or mastery, play is tremendously important for the individual. Play has been described as uneconomical, but this is a judgment that ignores its long-term benefits. In terms of immediate goals, playful activity is expensive in energy and time, but if the eventual behaviors of the adult are considered, it is a good investment of both.

Play is one of the most important factors in the establishment of social relationships that last a lifetime. The nonhuman primate is born into the highly structured social context of the group and the specific relationships its mother has with the group. Her personality directly and indirectly affects the infant's contacts with other group members–the effect may be restricting or it may be encouraging of wide contact. If the mother is very subordinate and constantly tense when she is near other adults, she may stay away from most of the adults and deliberately restrict the movements of her infant so that it will not be able to play. If, on the other hand, she is a confident, dominant, and socially active female, her infant may be in the center of action and have a lot of contact with other monkeys. A mother that is quick to threaten young that solicit her infant to play reduces the total amount of time her infant spends in play. Her presence, regardless of her temperament, certainly facilitates early exploration and play. Young of dominant females can afford to take liberties against other monkeys when the mother will back them up against reprisals.

Various types of play characterize different stages of development, each with its attendant problems and challenges. Play and other activities must have been designed through evolution to help meet the demands of each level of maturation. While we can observe social and motor tasks being worked out by infants and juveniles, the human can only guess at the psychological tasks. We cannot determine what, if any, utilitarian internal functions play has for the monkey.

Playful behavior gradually drops out of the repertoire of the monkey as it matures. Most adult male monkeys rarely, if ever, play, and the situation is similar for adult females although they may interact

playfully with their infants. In any event, play is not a notable feature of adult life. Why does it drop out along the way and why don't adults play?

There is no satisfactory or final answer to these questions, but it does seem that the following factors are relevant. The adult may find it too difficult to indicate playful intentions. The signals of playfulness, including the so-called play face, may not be sufficient to counteract the strength and potential ability to damage that other members of the group have learned to associate with that adult. Most play involves a lot of physical contact and sudden movements—two qualities of interaction generally avoided by adult males unless the situation is clearly one of relaxed grooming or similar activity. The rough and tumble of play may be potentially too dangerous for adults and also incompatible with their important roles of leadership and dominance. Intentions that are ambiguous or misread only once could mean the difference between safe play and a serious wound or fatality.

The adult monkey, and especially the adult male, is generally very sensitive to which other adult comes close to him. A sudden invasion of the adult's personal space or the area around him that he considers his private domain might be disastrous. The normal tensions of dominance relationships are seldom evident; in part they are hidden because the actors in the structure carefully avoid getting into situations where positions must be challenged. One of the best ways to avoid a fight is to avoid physical proximity. Play is contraindicated.

Baboons—Phyllis Dolhinow

Aside from these considerations—of animals getting too close, invading each other's personal space, or misreading the signals of intention—there is another, more basic suggestion as to why it is not worth the risk for adults to play. The learning activities of play, so important for the infant and juvenile, are no longer necessary for the adult. Presumably, by the time the individual has matured, it has mastered the skills it will need, learned the land it occupies, established its social relationships, and become coordinated motorically. Major forms of adult behavior are established and relatively immutable.

Mammals are so constituted that learning takes incredible repetition. Mastery comes slowly, and the years of immaturity are the time of life when they can afford the most mistakes. Increments of skill can only be seen over time and are based on the repetition and practice of activities like play.

Laboratory studies have demonstrated the importance of peer contact for the young monkey, but only field studies have indicated the full complexities of social life and the environment and their importance to the developing primate. The dangers and challenges of life in nature and the rewards to the individual of successful social life are only apparent in the field. The multiple functions of play may be obscure, indeed, when viewed for only a short time in an artificial context, and are not even obvious from watching only the young. The juvenile patas monkey jumping up and down in the tall grass may seem to be enjoying a nice sport, but the full importance of these motor patterns is not obvious until you see an adult male patas jumping to divert the attention of a lion from the rest of the group. Then the significance of this life-saving skill will reach the observer.

The healthy young monkey plays. It does so for a substantial portion of its immature years, and to a significant degree the success of its adult life may depend upon the intensity and variety of its play experience. Play in monkeys is more complex than the word signifies to most humans. There may be no fun in play, and it might be tension and anxiety producing for the playing monkey. Whatever the differences in form that play takes among the many different species of nonhuman primates, it is a major category of adaptive behavior that must be analyzed if we are to understand primate behavior.

Monkeys at Play

Pity the monkeys (and children) that are not allowed to play

by Stephen J. Suomi
and Harry F. Harlow
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In any zoo in the world, people almost always crowd around the facilities that house the monkeys. One reason primates are so popular may be that they look like furry little men with tails; another is that they are so entertaining. Young monkeys love to play, and their frolicking chases, wrestling matches, bar swinging, and ledge jumping bring awe to the face of a child, and to an adult, the wistful longing to be as agile and carefree. Our language is filled with references to monkey play–monkey business, monkeyshines, monkeying around, and monkey bars–references that connote a certain spirit of mischief and less than total seriousness.

But as psychological researchers at the University of Wisconsin Primate Laboratory and Research Center, we view the playful antics of monkeys with a great deal of seriousness. While most people watch monkeys for enjoyment, we observe the behaviors of our rhesus monkeys (*Macaca mulatta*) to gain psychological information. And we have found that of all monkey behaviors, play is probably the most informative. Merely noting the manner in which a monkey plays in a social situation can tell us the approximate age, sex, social position on the dominance scale, and rearing history of the animal, as well as permit us to make a fair prediction of a young monkey's future social capability and status, adequacy as a mother or father, and likelihood of developing abnormal behavior patterns. Systematic study of play behavior in monkeys has permitted the identification of variables that determine how, where, and with whom a specific monkey will play. More importantly, such research has promoted an understanding of the general function of play in social development, the process by which a helpless infant gradually becomes a competent, contributing member of monkey society. This function has implications for an understanding of human play. But before discussing them, we will describe the behavioral development of play of monkeys that are reared with mothers and peers in the laboratory.

An infant rhesus monkey spends most of its first month of life in the protective grasp of its mother. Its initial behaviors, such as clinging and sucking, are primarily reflexive and are directed toward maintaining tight physical and psychological contact with the mother. The infant gradually acquires voluntary control over some of its behaviors, and by the end of the first month it may stumble a few fledgling steps away from the mother, meticulously exploring any object it encounters. The mother does not permit her baby to venture beyond reach, however, and at the first sign of trouble she immediately retrieves the neonate and returns it to a ventral cradling position.

During the second month of life the infant monkey spends an increasing proportion of its time in exploration extrinsic to its mother and first comes into contact with other baby monkeys. Initially, the infant does not differentiate between other monkeys and the inanimate objects in its environment: both are interesting stimuli that are extensively explored, tactually and orally. As the baby monkey acquires greater muscular coordination, it begins to prefer mobile, animate playmates to static, inanimate playthings, and manipulative exploration gives way to interactive exchange. By three months of age the infant is stalking, pouncing, chasing, and wrestling with its peers and receiving ample reciprocation. By four months of age it has developed remarkable agility, ingenuity, and versatility in its repertoire of playful behaviors.

Between four and eight months the monkey's waking life is dominated by play activity, primarily of two forms. The first we call rough-and-tumble play, and it is best described as a monkey wrestling match. Physical contact is the rule, and it is indeed rough, including vigorous rolling, scrapping, clawing, and biting. Miraculously, no one gets hurt. The other primary form of play is more esthetically pleasing to watch. Termed approach-avoidance play, it represents the monkey version of the game of tag. The animals take turns chasing one another over all portions of the play area, but rarely come into physical contact. Rough-and-tumble play is characteristic of male monkeys, while approach-avoidance is typically a female monkey play pattern.

During these early months, other forms of activity emerge in the young monkey's play. One is aggression. Rough-and-tumble play becomes increasingly rougher as the monkeys grow older. In particular, biting is more vigorous and less playful, although never quite to the point of injury. Also, sexual posturing begins to occur as early as four months of age. Mounts and thrusts, precursors of male sex, increase in enthusiasm and proficiency during subsequent months, as does feminine posturing. Thus, behaviors that will mold adult interactions have their genesis in the play of the young monkey.

The occurrence of play begins to decline at about nine months of age, when it is superseded by real social aggression and its converse, social grooming. Monkeys one to three years old continue to play with vigor, but they play less often than they did in their younger days. Sexual maturation occurs between three and five years of age, and thereafter, play becomes infrequent. Monkey mothers may play with their infants, but seldom with other mothers. Monkey fathers are more apt to referee, than to join in, preadolescent games, although occasionally they will participate.

We have watched literally hundreds of monkeys growing up, and two aspects of their development have become increasingly obvious. First, a monkey mother greatly influences the development of play in her offspring. When her infant is under two months of age the mother is best described as overprotective. Her eyes are everywhere, and her arms readily retrieve the infant who begins to wander away. But the mother loses interest in her offspring as it matures. When the infant is between three and six months of age her protective nature wanes, and at times the baby's efforts to maintain maternal contact may be actively rejected. In addition, the infant is physically and psychologically shoved into the play area, and upon returning to its mother's cage, it is often vigorously punished. The infant soon spends more and more time away from its two-faced mother. We feel that in psychological terms, the mother provides her infant with an initial security before she gives it a healthy kick in the tail. A baby monkey made bold will not be afraid to play.

Robert Dodsworth

The second element we notice is sexual in nature. Beginning very early in life young male monkeys differ from young female monkeys in their behaviors. These differences are first and foremost evident in play. Males play more actively, physically, and aggressively than females. Few females get caught in rough-and-tumble play, and in approach-avoidance exchanges they are chased more than they pursue. A female infant rarely initiates a play bout with a male. Male monkeys, however, try to play with anybody and anything.

As infants grow older and play becomes more sophisticated, sex differences become more obvious. By six months of age males are far more active and enthusiastic in their over-all play behavior than females. Furthermore, sexual posturing and positioning become more sex-appropriate. Initially, both males and females mount and thrust, which are adult male sexual behaviors, and both exhibit the adult female sexual "present" with equal frequency and proficiency. By seven months, however, female mounts are infrequent and are directed almost exclusively toward other females. Males may present toward other males, but seldom toward females. In addition, female monkeys groom their peers considerably more than do males. These differences emerge regardless of whether male or female adults are present. The differences persist, in modified form, through adulthood. We strongly believe that they are biologically determined.

The development of play, which we have described for laboratory monkeys reared with mothers and peers, is chronologically identical to the development of play demonstrated by feral monkeys. If all monkeys exhibited a similar development, monkey play would be of little more than casual interest. But some of our monkeys at the Wisconsin Primate Laboratory and Research Center do not show normative play development. We have learned from the study of these primates that monkey play is of overwhelming importance.

If one raises a group of infant monkeys without mothers or fathers, they soon develop patterns of mutual clinging behavior. For some six to eight months, mutual clinging is essentially the only behavior these together-together infants, as we call them, show. Mother-peer reared monkeys initially cling a great deal to their mothers, but by four months of age they have been actively pushed into a socially interactive world. Together-together reared monkeys have no mothers to send them out to play, and therefore they keep clinging to each other. Eventually, usually by six to eight months, play behavior does emerge in these animals, but it is unsophisticated and passive. Together-together rearing retards the development of play, and when it finally emerges it is of an infantile form.

One can also rear an infant with its mother while denying it the opportunity to interact with peers. When monkeys so reared for the first eight months of life are finally exposed to peers, they are hyperaggressive. They avoid efforts by other monkeys to achieve physical contact, but initiate intense biting attacks that are more aggressive than playful in nature. Among humans, "mama's boys" are seldom popular or effective playmates. In monkeys, mother-only reared infants are at once socially withdrawn and unusually aggressive.

The behavioral anomalies exhibited by together-together and mother-only reared infants are somewhat ameliorated as the animals mature. Both types of monkeys exhibit relatively normal sexual behavior at adulthood, and the females become adequate mothers, but the developmental discrepancies do not entirely disappear. Adult together-together reared monkeys are timid animals, and adult mother-only reared subjects continue to be hyperaggressive in social situations. Thus, analysis of play behavior exhibited by these animals as infants affords a relatively accurate prognosis of their social capabilities as adults.

The above disturbances seem mild indeed when compared with the behaviors exhibited by monkeys subjected to more sterile rearing environments. If one rears infants in bare wire cages where they can see and hear, but not physically contact, other monkeys, the young animals rapidly develop obvious disturbances. Having no mother or peers to cling to, these monkeys embrace their own bodies in intense self-clasping. Having no maternal nipple to suckle, they suck and chew their own digits. Thumb and finger sucking, common among human infants, is augmented by toe sucking and, among males, penis sucking—a manifestation of the monkey's greater physical flexibility. Having no playmates to provide motor stimulation, wire-cage reared infants develop compulsive and stereotypic rocking behaviors, strikingly reminiscent of the human autistic child.

When monkeys so reared are finally exposed to peers, they do not exhibit play behavior. Rather, they avoid social interchange and continue in their self-directed, self-satisfying behaviors. If surrounded by peers they may initiate an aggressive attack, but more often they are the victims of aggression. The difference between these social misfits and their equal-aged playful peers is striking and sobering even to the most naïve observer.

All work and no play makes for a dull child. No play makes for a very socially disturbed monkey. When wire-cage reared animals reach physiological maturity they are incompetent in virtually every aspect of monkey social activity. They prefer to sit in a corner, rather than engage in social grooming, a prerequisite of monkey etiquette. Their aggressive behavior is both ill-advised and ill-directed. Wire-cage reared adults will viciously attack a helpless neonate or they may suicidally attack a dominant male—an act few socially sophisticated animals are stupid enough to attempt. In the absence of social agents, wire-cage reared monkeys will attack themselves, occasionally rending skin and muscle to the bone in a flurry of self-aggression.

Monkeys denied the chance to play at sex are seldom proficient at sexual play. Although their hearts may be in the right place, more important things are not. A wire-cage reared male may attempt to mount the front or side of a willing female. Equally often he will sit next to her and masturbate. Wire-cage reared females do little better. It is our conclusion that impregnation of these females is best achieved via artificial insemination procedures.

When such females become mothers, another adverse consequence of lack of early play interaction becomes obvious. Motherless mothers, as we call them, are not good mothers. Most females cradle their newborn infants almost continuously. These females will leave their babies lying on a mesh floor or, if provoked, will crush them into the wire surface. If further provoked they may bite off an infant's fingers or toes.

We have found that even more severe behavioral disruption can be achieved by rearing monkeys for the first six months or more of life in total social isolation, where they receive neither visual nor physical social stimulation. Surprisingly enough, such rearing has little apparent effect on the monkeys' intellectual capabilities. They solve learning test problems—with the exception of extremely complex learning problems—as rapidly and with as few errors as do mother-peer reared, laboratory-born monkeys or their feral-born counterparts. A monkey does not need playmates to perform adequately in intellectual endeavor, but it sorely needs them to become a functioning member of a social unit. A similar observation regarding human behavior might not be far from the truth. From our observations it has become clear that play is of utmost importance for the subsequent social well-being of the individual and those around him. Why should this be the case?

We think that play among monkey infants serves two general, but important, functions. First, it provides a behavioral mechanism by which activities appropriate for adult social functioning can be initiated, integrated, and perfected. Play repertoires of monkeys under a year of age contain rudimentary forms of virtually all behaviors that characterize adult social life. Patterns of social grooming, aggression, sex, and dominance are clearly evident in infant monkey play activity. When they first emerge, these patterns are not exhibited at adult levels of competence. Rather, they are clumsy and unsophisticated. It is only after months, even years, of "practice" that the behaviors become truly adult in form. The practice comes through peer play.

It is primarily through play that young monkeys learn to interact in a social world. In the months of early play development the infant progresses from a recognition that social objects differ from the rest of the environment to a state of living with and loving fellow monkeys. Presence of peers is sought, rather than avoided, as with isolate-reared monkeys. Furthermore, the infants pick up social graces, such as how to behave in the presence of a dominant, as opposed to a lower status, peer. Dominance hierarchies established among peers early in life persist, unchanged in form, throughout adulthood. In these respects, the function of play for monkeys closely parallels the role of play among human children.

The second function of play in monkey social development is to mitigate aggression when it emerges in the monkey's behavioral repertoire. Aggressive behavior, absent in very young monkeys, seems to manifest itself spontaneously at about seven months of age, independent of rearing conditions. For this reason we believe aggression to be genetically predisposed in the rhesus monkey. All monkeys show aggressive behavior of some form, beginning at seven months of age. However, the situations in which aggressive behavior is exhibited are controlled, not by genetic, but rather by social variables. Monkeys permitted to play exhibit their aggression in their play activity. Because it is part of the play repertoire, it is of relatively mild form. Through play, the control of aggression is achieved.

What happens to aggressive behavior when infants are denied the opportunity to play with peers? In the case of mother-only reared infants, hyperaggression characterizes otherwise normal peer interactions. These monkeys, having received adequate maternal contact, are not afraid of other monkeys, but they control their aggression poorly in their social activity. In contrast, wire-cage and isolate-reared monkeys are generally incompetent in social situations. Like all other monkeys, these subjects exhibit aggressive behavior, but it is neither under effective control nor is it target appropriate. Such monkeys will aggress with equal ferocity against infants, dominant adult males, and their own bodies. They have had no practice in channeling their aggression through alternative forms of social behavior.

There is definite survival value in aggression as long as it is socialized. Monkeys in the wild must protect their social groups from predators and from competitive monkey troops. Without aggression there would be little protection. However, aggression directed unsystematically toward fellow group members can destroy any society. Hence the response must be attenuated in intragroup interactions. We believe that a major function of play is the development of control over the intensity and the target of aggressive behavior. Play very likely has a similar function for humans. One only has to watch a professional football game to be convinced.

As we examine how play develops in monkeys, and the consequences of its lack of development, it becomes obvious that play, which appears to be so spontaneous, carefree, and frivolous, is actually one of the most important aspects of social development. The next time you go to a zoo, stroll over to the monkey island and revel in the playful antics of man's evolutionary cousins. Then pity the monkeys who are not permitted to play, and pray that all children will always be allowed to play.

A play-deprived monkey—Robert Dodsworth

The dynamic principle
of fantasy is play,
which belongs also
to the child, and as such
it appears to be inconsistent
with the principle
of serious work.
But without this
playing with fantasy
no creative work
has ever yet come
to birth. The debt
we owe to the
play of imagination
is incalculable.

Carl Gustav Jung

Celestial Events

After new moon on December 17, the early crescent appears in the evening sky, followed by the first-quarter moon on December 24 and the full moon on December 31. The moon starts the new year in the morning sky, passing through last-quarter on January 8.

In late December and early January, Venus, Mars, and Saturn are found in the evening sky. During late evening twilight, you will see Venus, brightest of the three, down in the southwest; Mars, the dimmest, well to the left and well up in the south; and Saturn high in the east. Venus sets about an hour and a half after it becomes visible, and Mars sets about midnight. Saturn, in Taurus, to the north of, and brighter than, the orange star Aldebaran, remains visible until well past midnight, when it sets to the north of west.

Both Jupiter and Mercury are in the morning sky, rising about dawn. Jupiter probably can be found low in the east in the early dawn by mid-January. Mercury goes through a favorable morning elongation that brings it more than 15 degrees above the eastern horizon before sunrise. It may be seen best as a morning star for about a week before and after it reaches greatest elongation on January 1.

December 19: Venus will be just left of the lower horn of the crescent moon in the early evening sky tonight.

December 22: The sun arrives at the winter solstice, where it is located over the most southerly part of the earth from which it appears directly overhead, approximately latitude 23° 26′ S. On this date, autumn ends and winter begins in the Northern Hemisphere at 7:24 A.M., EST. This is also the date on which the sun spends the shortest time over the horizon in the Northern Hemisphere. Mercury becomes stationary and resumes direct (easterly) motion.

December 23: The weak Ursid meteor shower reaches maximum, about 15 meteors per hour. The moon sets before midnight.

December 24: Mars, almost directly below the first-quarter moon, becomes visible in late twilight this evening. The moon separates to the left as both move into the western sky, to set about midnight.

December 29: Saturn rises just below the moon early this evening. The moon moves closer to the planet until midnight (EST), when conjunction occurs, then moves away from Saturn.

January 1: Mercury is at greatest elongation (west) in the morning sky. Mercury stands more than 15 degrees above the eastern horizon at sunrise and may be seen as a morning star, close to the horizon in early twilight, for about a week before and after this date.

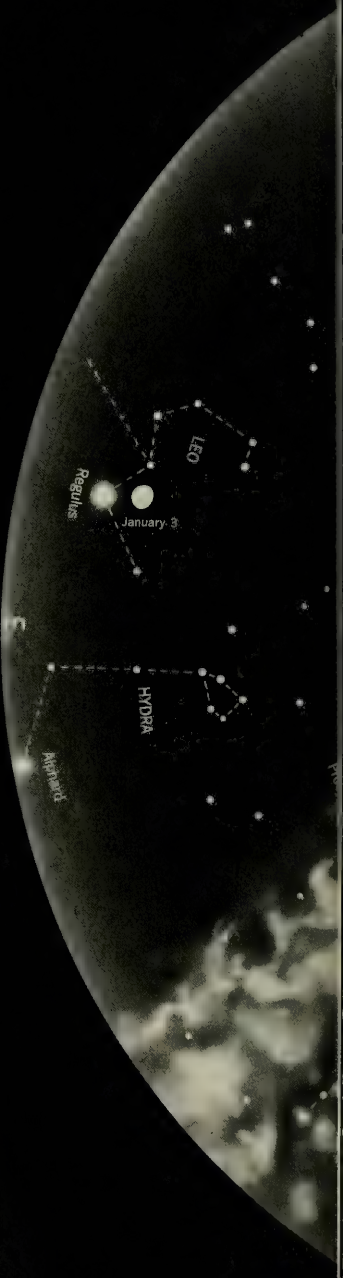
January 3: Earth is at perihelion, the point in its orbit where it is nearest the sun for the year.

January 3–4: The bright star near the moon on these evenings is Regulus, in Leo.

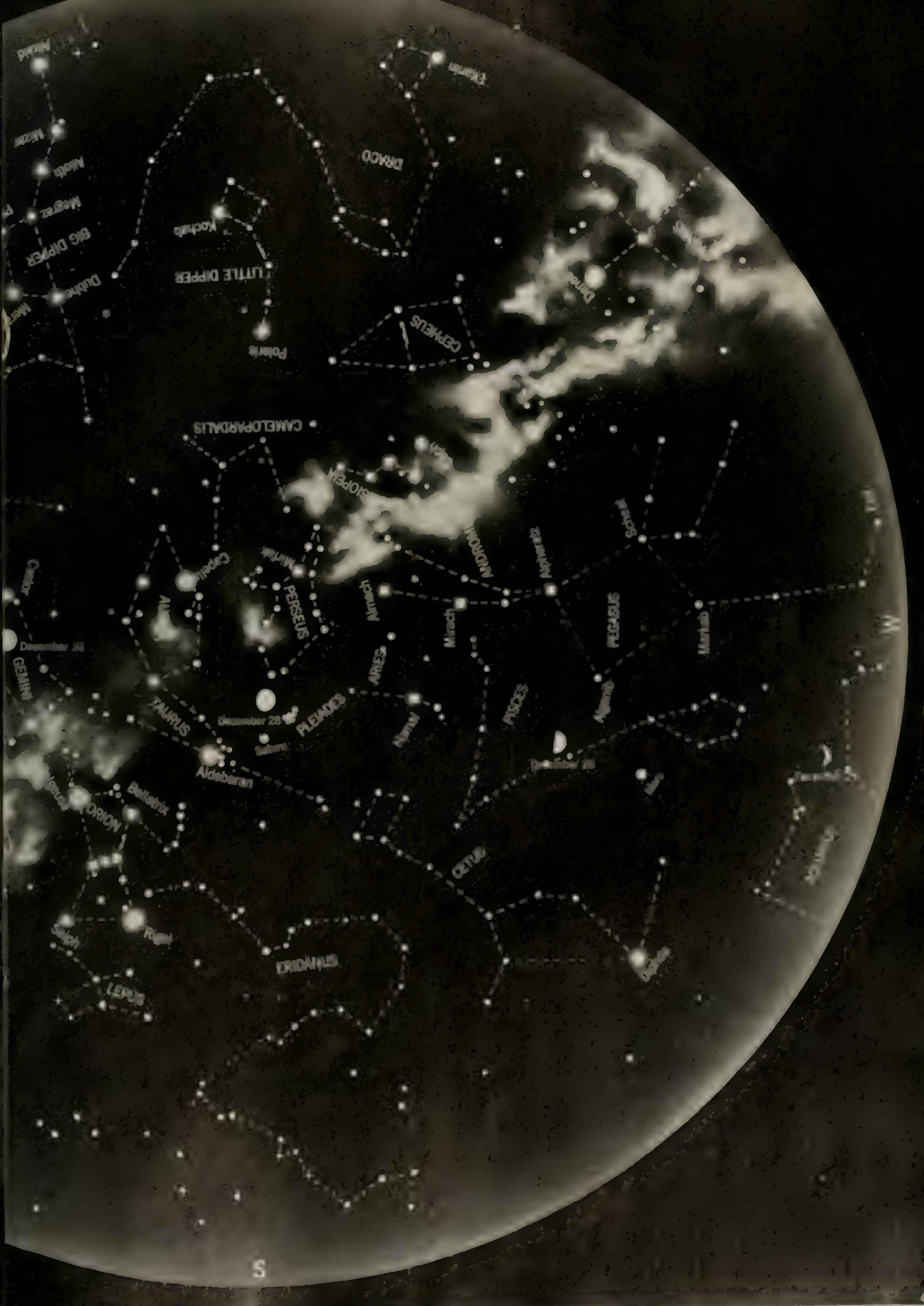
January 6: Mercury and Jupiter are close in the sky this morning, but very low in the east in early twilight. Jupiter is the brighter of the two, and Mercury will be slightly above and to the right.

January 14: You may be able to find Jupiter more easily this morning by looking above the rising crescent moon. The bright planet is above and a little to the left.

THOMAS D. NICHOLSON



→ Hold the map [illegible] direction you face is at the bottom; then match the stars in the [illegible] of the map with those in the sky near the horizon. The map is for 10:20 P.M. on December 15, 9:20 P.M. on December 31, and 8:20 P.M. on January 15, but it can be used for about an hour before and after those times.


Alkaid
Mizar
Alioth
Megrez
BIG DIPPER
Dubhe
Merak
DRACO
Etamin
Kochab
LITTLE DIPPER
Polaris
CEPHEUS
Deneb
CAMELOPARDALIS
SIOPEI
Capella
AU
Mirfak
PERSEUS
Almach
Mirach
ANDROMEDA
Alpheratz
Scheat
PEGASUS
Markab
Algenib
ARIES
Hamal
PISCES
Castor
December 28
GEMINI
TAURUS
December 28
Saturn
PLEIADES
Aldebaran
December 28
Betelgeuse
Bellatrix
ORION
CETUS
Rigel
Saiph
ERIDANUS
Diphda
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Fly in the Sundew

by Terry Ashley and Joseph F. Gennaro, Jr.

Radioactive marking makes it possible to see just how this pretty little carnivorous plant digests its prey

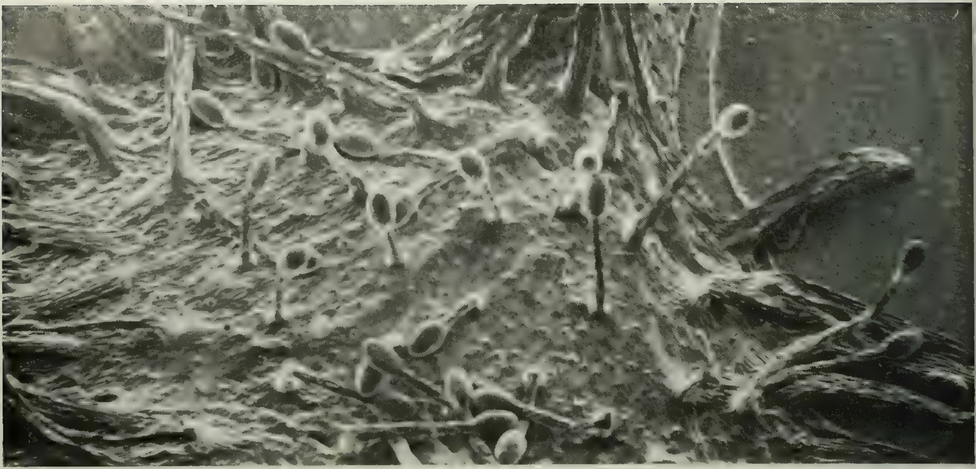
A delightful botanical adaptation is the apparent ability of some plants to digest and thrive on animal material. These organisms represent very special ways in which plant life deals with its environment, ways directed toward subsistence. Almost without exclusion, plants that carry on carnivorous activity, or "carnivory" as it was called by Charles Darwin, are relatively primitive in their structure, especially in their root systems. Whether root development failed to occur in these forms because they obtained nitrogenous material from animal life around them or whether they developed this ability because their root systems could not supply enough nutrients is probably unanswerable. These conjectures are separate, however, from the purpose of our experiment. The question that occurred to us was: "Is it possible to prove that a carnivorous plant actually digests the insects it catches and assimilates material from them?" We worked with the sundew because it is easily available and has a structural peculiarity that, as was first pointed out by Darwin, makes it ideal for experiments of this kind.

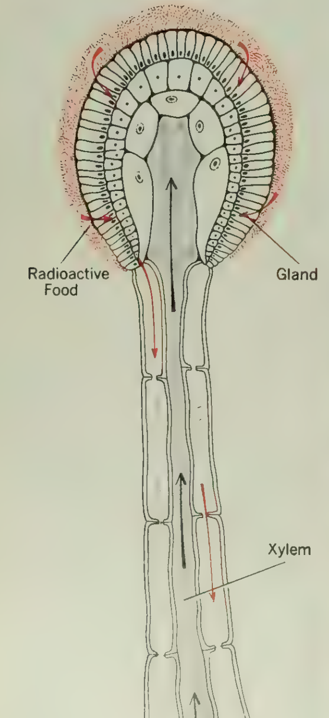
In his small book *Insectivorous Plants*, Darwin describes the results of two years of laboratory experimentation with these plants. Clearly and methodically, his account progresses from one question, through conclusions, to the next question until, it would seem, he has completely characterized the organism. He devoted himself to careful observation of the structure and function of several of the insectivorous plants, among them the sundew and Venus's-flytrap.

His experiments are recorded in his own style. Each is preceded by a question; his manipulations to obtain an answer to that question are described, together with his interpretations of his observations and the next question to be answered in the logical sequence toward clarification of the nature of the organism. As his knowledge grew, his questions became more complex. He was interested in the structure of the plant, its growth characteristics, and its reaction to feeding, whether the food was a bit of meat or a glass bead. He also wanted to know whether the plant, which put forth digestive juices only when stimulated by meat, actually assimilated the products of this digestion. His work, and the work of his son Francis, demonstrated that plants that were fed meat grew larger, had more leaves and flowers, and produced more seeds than plants that were covered by inverted glasses so that they could not feed. His experiments were so clear and direct that one remains impressed with the elegance of his reasoning and doubtful that anything remains to be done in the way of further investigation.

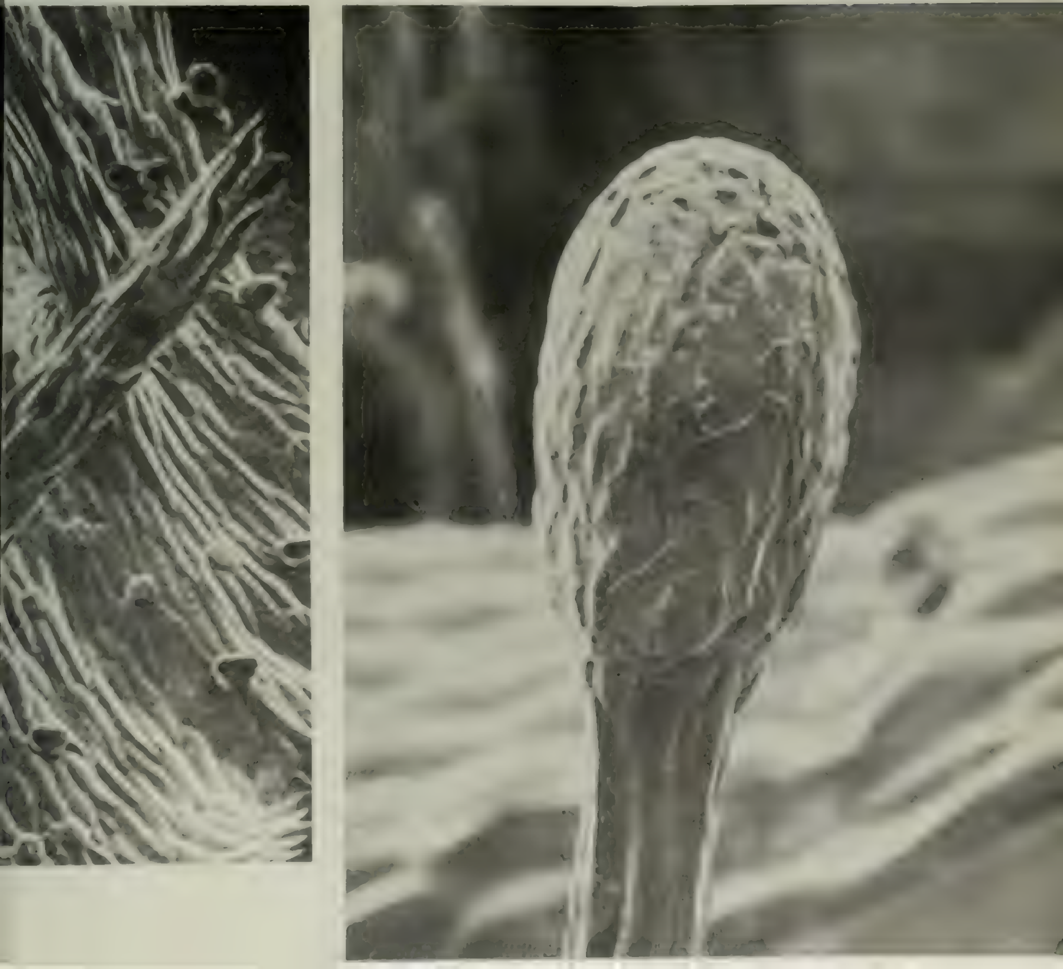
As a matter of fact, were it not for the discovery and general availability of synthetic radioactive materials, it would be difficult to improve on Darwin's data and experiments of one hundred years ago. Because it is now possible to distinguish certain radioactive atoms from nonradioactive atoms of the same elements, we felt that we could demonstrate quantitatively the processes that the Darwins and a few successors had reasoned to exist. Although this could be done by utilizing radiolabeled building blocks of tissues, such as amino acids or partially digested mixtures of protein from plant or animal sources, we chose to use radioactive insects to duplicate more closely the natural conditions we wished to investigate. For our radioactive label we chose radiophosphorus (P^{32}) because the kind of radioactivity it gives off is easy to detect and work with and because phosphorus is an element that probably occurs in every known biochemical pathway and process having to do with carbohydrate, lipide, protein, and nucleoprotein metabolism. Using phosphorus, we could detect assimilated insect material in the plant whether it took up all these constituents or only one or another biochemical.

The sundew structure is admirably suited to this kind of experimentation. It is a small plant (2½–3 inches across) with a shallow root system, and grows well in a wet environment—in bogs poor in available nitrogen. Above the ground the plant is distinguishable by a rosette of eight to fifteen club-shaped leaves, each about an inch long and not quite half an inch in breadth at the widest portion. The upper, or exposed, surface of this widening in the leaf is covered with hairlike structures, about one-eighth to one-fifth of an inch long. Each of these possesses a small enlargement at the free end. The hair and the enlargement are called the




Radioactive Food
Gland
Xylem

Tentacles on a sundew leaf are shown at magnifications of 65, 500, and 1,120 through a scanning electron microscope. Normally the tentacles would be erect; some of these have been damaged during preparation for study. The small lumps on the surface of the leaf appear to be some type of gland, but experiments prove most digestion of a trapped insect takes place through the tentacles. The stringy material on the tentacle head at lower right is believed to be dried mucus. In the diagram, the transport mechanisms of the tentacle are shown. Water and other fluids are supplied through the central canal, part of the xylem; radioactive material from the fly moves down through the outside layer of cells.



tentacle." The enlarged area has een described as the region in hich the digestive and mucous lands reside. The evidence for the ucous glands is the crystal droplet f sticky secretion that always surounds the enlargements. The hole of these produce the striking spect that gives the plant its name.

According to Charles Darwin, diestion and absorption of materials ake place when nitrogenous mateial is placed in one or more of hese tiny droplets. This is begun y the secretion of digestive enymes from the tentacle gland. timulation of the gland by touchng it with a glass rod will not elicit he enzymes. Supposedly, the digesive enzymes released by the gland fter an insect has been captured ill dissolve the material in the inect's body; this material is then asimilated through the fine stalk of he tentacle. Assimilation aparently takes place only through he tentacle or tentacles that are in ontact with the insect and not, as e shall see, through the surface of he leaf itself.

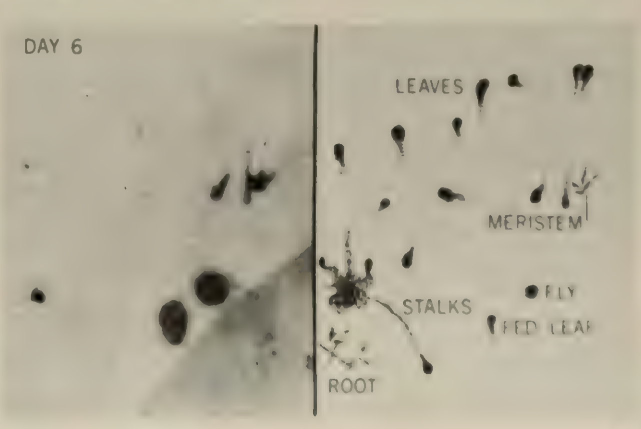
Because of the delicacy of the mall structures involved on the eaf, we chose to use a tiny insect in hese experiments. We selected the ruit fly, the small animal from which so much scientific informaion has already come, because it ould be attached to only one tenacle gland. We cultured fruit flies n covered dishes in which sugar soutions, yeast, and radiophosphorus ad been placed. The insects grew at a great rate, and by the time several generations had developed in this system each insect was extremely radioactive.

We collected and killed the flies to minimize the number of radioactive fruit flies flying around the laboratory and to make it possible to attach the radioactive insect precisely to one or more glands or leaves quickly and easily without concern that the fly might escape. In a typical experiment, a fly was washed to remove surface radioactivity and placed on the end of a single tentacle gland. After several hours or days, the fly was removed from the "fed" leaf. The plant was then dissected and the radioactivity measured, both in a radiation counter and by placing the leaves against a sheet of photographic film until the radioactive material left an impression that could be developed by the usual means. In this way, it was possible to determine quantitatively the distribution in the plant of the radioactivity removed from the insect. The fed leaf, the roots, flowers, other leaves, and the meristem, or growing tissue, were all assayed for radioactivity. By the autoradiographic technique it was possible to actually visualize the distribution of the radioactivity within the leaves and other plant tissues (*below*). The graph (*page 102*) illustrates the rate of removal of the radioactive material from the fly and its incorporation into the plant.

The rapidity of the process is surprising, considering the tiny filament through which the nutrient material must flow, and even more so when one considers that the central canal of the tentacle is part of the xylem of the plant, that system of vessels devoted to the *outward* flow of materials. The canal presumably carries water and precursors for the glandular secretions to the tip of the tentacle. According to W. H. Ariz of the University of Groningen, the Netherlands, the inward flow is accomplished by intra- and inter-cellular transport of the digested materials through the single-cell layer that makes up the wall of the filament. In plants this is facilitated by the presence of plasmodesmata, or protoplasmic bridges, which connect plant cells. This arrangement implies that the absorption of all the nutritive material from the tentacle must take place through the cells surrounding the internal canal. In view of this, the rate of absorption of substance from the fly seems rapid, even though the amount of material transported must be small. The loss of radioactivity from the fly placed on the tentacle gland is very rapid at first and only diminished after a day or two. As might be expected, the distribution within the plant of this assimilated nutrient material is first to the leaf on which the tentacle is situated; next, the material moves rapidly through the plant until the greatest concentration is in the growth center, or meristem. Here the small number of rapidly

Continued on page 102

wasp-mimicking flower is trapped by sticky mucus on the tacles of a sundew.



Bits of radioactive plant and fly made these blotches on a piece of film. The diagram at right identifies what was placed on the film. The root and some leaves did not register

The Melancholy Addictio

"Fust time I see de boll weebil
he sittin' on a square.
Nex' time I see de boll weebil
he got his fambly dere"

After a quarter-century of modern pest control, a third line could be added to this old folk song: "Now when I see de boll weebil, his fren's is ever'where."

Cotton today is one of the world's most "bugged" crops, victimized by an ecological backlash to heavy insecticide drenching. The sad state of the cotton ecosystem stands out as a model of the worst in pest control. The heavy use of pesticides has created an entomological nightmare, bringing in its wake economic ruin, human illness and death, and gross environmental pollution.

Why cotton? How was this ecosystem, this crop, programmed for disaster?

First, as the folk song reveals, the cotton plant historically has been plagued by a variety of destructive pest insects. Secondly, cotton is a cash crop, both for the individual grower and for governments seeking foreign exchange. Therefore, cotton often becomes a political crop. Governments play with it: setting acreage allotments, fixing prices, paying cash subsidies to growers, making barter arrangements with other countries.

Because of these factors, wherever cotton is grown farmers use insecticides almost compulsively. The sight or even thought of a boll weevil, lygus bug, spider mite, or pink bollworm triggers an automatic reaction: kill it before it takes a nickel out of your pocket, a crumb from your mouth, or a dollar out of the treasury! Most growers, whether on their own resources or financed by banks or ginning companies, use insecticides prophylactically, often because of pressures from the lending agencies.

In the United States the cotton subsidy system has also fostered excessive use of insecticides. Subsidies are based on average yield records: the higher the average over a prescribed number of years, the greater the subsidy. The grower, believing that "insect-free" cotton is a critical element for maximum yield, often uses insecticides prodigally, regardless of pest infestation levels. To him the cost of insecticides is insignificant compared to the potential earnings from subsidies.

Governments, too, become extremely nervous over cotton insects. A number of countries that barter cotton for manufactured goods or earn substantial foreign exchange from cotton exports are obsessed with the same urge as individuals to maximize the current crop by protecting it from insects. Again, this means heavy insecticide usage.

Finally, there is the influence of the pesticide industry itself. Cotton growers are among the greatest insecticide buyers, and the chemical producers compete fiercely for a slice of the pie. In the United States alone, cotton insecticide sales exceed $100 million annually. There are other great markets in Latin America, Africa, the Middle East, and the Orient.

Many pesticide companies play on the apprehensions of growers and governments, bombarding them with advertisements and "free" technical advice. Often these companies give grants and provide experimental materials to research institutions. The institutional staff members are entertained, showered with little gifts, and may even be given funds for travel abroad. Individual growers and governments are offered discounts on proprietary materials. And in some instances, agricultural officials are bribed to approve the purchase or use of specific materials. (An embittered insecticide company representative once related to me in detail how, at the last minute, he lost a contract with a Middle Eastern government when an agent of a rival company bribed a key official in the country's Ministry of Agriculture.)

If individuals or governments are coaxed, tricked, or bribed into excessive use of insecticides, why not just forget it and let them suffer the consequences of their own stupidity? Unfortunately it doesn't work out this way, and many innocent victims have been caught in the backlash of the insecticidal overload. The result has been massive economic, sociological, and ecological adversity.

The basic problem lies in the ecological crudeness of most modern insecticides and the patterns of their use. The materials are designed to kill the broadest possible range of insects. Thus, when applied in the field, they kill indiscriminately, destroying the predators and parasites of pests and potential pests as well as the pests themselves. This severely disrupts the delicately balanced insect communities that occur not only in

f Ol’ King Cotton

by Robert van den Bosch

complex natural ecosystems, but also in more simplified agricultural plantings. With the natural balance disrupted, the treated planting becomes a virtual biotic vacuum in which the target pests often rapidly resurge to pretreatment or even higher population levels (target pest resurgence), while previously innocuous species, unleashed from their natural enemies, erupt to damaging abundance (secondary pest outbreaks). This frequently entrains an insecticidal treadmill, for to avert damage by the resurgent or unleashed pests, the grower is forced to reapply insecticides. This is the beginning of insecticide resistance in the pest populations.

The mechanics of resistance begin with the first application of pesticide. Part of the pest population always survives. As treatments are repeated, the susceptible individuals are winnowed from the population until eventually it is composed largely or entirely of resistant members. Because the generation interval of pests is often brief, the surviving insects quickly breed large pesticide-resistant populations. These resistant pests thrive in the new environment, where many of their competitors and natural enemies have been eliminated by the broad-spectrum insecticides.

In an attempt to control the resurging pest population, dosages are increased, materials are applied in mixtures, and treatment intervals are shortened, but these efforts only serve to select for even greater resistance. Finally the pest is uncontrollable and free to ravage the crop. The price of this trip to insecticide addiction is economic and ecological chaos.

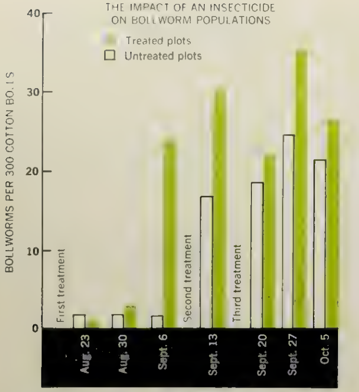
Cotton, as the world’s major recipient of the insecticidal overload, has suffered the consequences of this addiction more than any other crop. Major insecticide-induced breakdowns of cotton ecosystems have occurred in a number of areas—South and Central America, Mexico, the Rio Grande Valley of Texas, and the Imperial Valley of California. The landmark disaster occurred in the Cañete Valley of Peru in the early 1950s.

The Cañete is one of a number of Peruvian coastal valleys that are self-contained agroecosystems. Major cotton production in this valley began in the 1920s. Until the late 1940s cotton growers controlled a limited pest insect complex with old-fashioned insecticides such as calcium arsenate and nicotine sulphate. Then the growers, opting for modern pest control, shifted to the new synthetic organic insecticides, mainly DDT, benzene hexachloride (BHC), and toxaphene. During the first years, the modern pesticides effectively killed insect pests. Striking increases in yields were recorded. Because of the success, the growers spread a virtual blanket of insecticides over the valley.

But the miracle was short-lived. Some of the pest species began to develop resistance to the insecticides. Old pests became increasingly destructive and new ones appeared. By 1952 BHC was no longer effective against the cotton aphid, and by 1954, toxaphene failed to control one of the leafworms. Quickly, a general pattern of resistance to organochlorine insecticides developed. The growers turned to the deadly organophosphates. But the pests, which had doubled in number, rapidly developed resistance to these too. The growers had to increase dosages and shorten treatment intervals. By the 1955–56 season, insect resistance to the organophosphates was general, the pests were rampant, and the crop suffered severe losses. The yield for the 1955–56 season was one of the lowest ever recorded in the valley.

To rescue the cotton industry, the Peruvian growers broke away from the insecticide treadmill and invoked an integrated control program that, among other things, included a reversion to the old, nonsynthetic insecticides, adjustments in agronomic practices, and rehabilitation of the natural enemy fauna. The pest problem abated rapidly. Secondary pests, which had been triggered to damaging abundance by the synthetic insecticides, faded into obscurity. The old regulars subsided to their former levels. Damage decreased and yields jumped. Under integrated control, Cañete Valley cotton production quickly reached its highest levels in history and remained there.

The Cañete Valley disaster has recently had a sequel in Central America. The problem there, however, is of greater magnitude and has serious effects outside the cotton fields. The pattern of target pest resurgence, secondary pest out-



In tests at Dos Palos, California, bollworm populations decreased in sprayed plots immediately after the first treatment, but within a week the treated plots had more bollworms, despite repeated applications of insecticides.

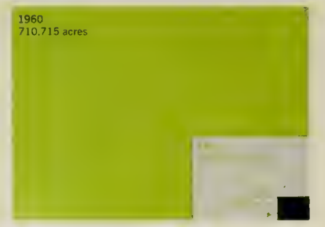
break, and pesticide resistance has developed in hundreds of thousands of acres of cotton extending over much of the Pacific plain of Central America. Production costs have soared, yields have dropped, and the adverse impact on the environment has been enormous. Yield losses have had a particularly severe economic effect because several of the Central American countries depend heavily on cotton for foreign exchange earnings.

But the economic woes of Central American cotton are only part of the insecticide-induced disaster. The direct impact of the materials on the human population has also been severe. There have been thousands of insecticide poisonings and hundreds of deaths, particularly among the peasant population. And recent studies in Guatemala have shown that DDT and BHC residues in mother's milk are the highest ever recorded anywhere. In an extreme case, a sample of mother's milk contained 244 times as much DDT as would be permitted in commercial cow's milk in the United States.

Another public health menace associated with the insecticide treadmill in Central American cotton is the rising threat of a malaria epidemic due to the increasing insecticide resistance of the malaria-carrying mosquito *Anopheles albimanus.* This resistance is partly a product of the veritable chemical cloud that recurrently covers much of the countryside during the cotton-growing season. Recent studies in Central America indicate that malaria is on the increase.

Politicians, agriculturists, and public health officials, aware of the worsening situation in Central America, are beginning to seek answers to their problems. One can only hope that the right action will be taken before complete disaster occurs.

In two areas of northeastern Mexico, the "right action" did not come soon enough; in both places the pesticide treadmill destroyed the cotton industry. In this case, a single species, the tobacco budworm, largely caused the disaster. Formerly an innocuous species, the tobacco budworm was unleashed from its natural enemies by insecticides used to control the boll weevil and cotton fleahopper. The inherently tough tobacco budworm became tougher as repeated exposure to insecticides eliminated the weaklings from its population. Eventually, no insecticide dosage or combination could kill it. Despite repeated drenchings, the insect literally munched into extinction three-quarters of a million acres of cotton at Matamoros-Reynosa and later a half-million acres at Tampico-Ciudad Mante. The cotton crop at Matamoros-Reynosa once had an annual value of about $50 million, that at Tampico-Ciudad Mante about $33 million. Now these once prosperous regions are experiencing a severe economic depression.



Cotton acreage declined in the Matamoros-Reynosa area of Mexico after pests developed resistance to insecticides.

Across the Rio Grande in Texas, symptoms of a similar debacle have appeared. The tobacco budworm has become increasingly difficult to kill, damage caused by it has increased, and pest control costs have spiraled. But the Texans are trying to get off the insecticide treadmill. They realize that early-season treatments for the boll weevil and cotton fleahopper create the budworm problem, and they are trying to minimize such treatments. But in years of heavy boll weevil or fleahopper infestations, extensive insecticide treatment is necessary and, as happened in 1970, this triggers a severe tobacco budworm outbreak. Somehow, the early-season treatments must be eliminated, but there is no easy solution to this problem. The Texans are hoping that they can live with the problem until they have developed an integrated control program, perhaps one in the pattern of that worked out in the Cañete Valley.

The cotton industry in the Imperial Valley of California is at about the same stage of economic and ecological collapse as that of the Rio Grande Valley. An invading pest, the pink bollworm, has almost ruined the industry. The pest invaded the Imperial Valley, presumably from Arizona and Mexico, in the mid-1960s. The lush valley, with its torrid summers and mild winters, seems to be an ideal environment for the pink bollworm, for the pest has prospered there as it has nowhere else. Of course, human bungling has helped it.

When the pink bollworm arrived in the Imperial Valley, cotton growers, government pest control agencies, and politicians—all in an atmosphere of hysteria—made several major mistakes. First they undertook an ill-advised attempt to eradicate the pest with insecticides. This plan was foredoomed. Insecticides are not particularly effective against the pink bollworm,

In most ecosystems natural predators control pest insects. Here, a carabid beetle, *Calosoma affine*, is shown feeding on the larva of an armyworm, *Spodoptera praefica*.

whose larvae feed cryptically in seeds. And contiguous infestations in Arizona and Mexico assured continuous reinfestation of the valley. Not only did the program fail, it also had unfortunate secondary effects: (1) thousands of dollars, which could have been invested in research on integrated control, were squandered, (2) tens of thousands of honeybee colonies were destroyed, (3) a devastating secondary pest outbreak was triggered, (4) insecticide resistance was accelerated in the worst of the secondary pests, the cotton leaf perforator.

Next, an attempt was made to eradicate the pink bollworm by the sterile male technique. But the technology for successful application of the technique had not been developed, and again a large amount of money was expended on a program that failed.

Meanwhile, the growers, whose self-imposed assessments had been largely plowed into the "eradication" programs, still had the pink bollworm in their fields. They fought it in the only way they knew—with chemicals. And predictably, the familiar pattern unfolded: costs for insecticides soared, secondary pests appeared, resistance developed, yields dropped. Furthermore, the 50,000 acres of cotton in the Imperial Valley became an enormous insectary from which millions of insects boiled out over the countryside, infesting adjacent crops. Additional pests were unleashed because their biological controls had been disrupted by insecticides that drifted from the treated cotton fields. The main culprit was the beet armyworm, which developed devastating infestations in sugar beets and alfalfa and also caused damage to lettuce. Aphids, too, occurred in unprecedented abundance.

In 1970, cotton yields in the Imperial Valley were the lowest of the post World War II era. Pest control costs were staggering. The growers considered a year's moratorium on cotton production as a possible way to break the pink bollworm cycle and its attendant insecticide treadmill. But agreement on a moratorium was not reached, and the Imperial Valley received another insecticide drenching during the 1971 growing season. Early reports indicate that this year's cotton yields will be close to last year's low output.

The major hope for cotton in the Imperial Valley appears to be in early maturity of the crop, early harvest, and early destruction of crop residues. This would prevent heavy buildup of the pink bollworm in the autumn, which results in a large overwintering (hibernating) population. But research on such a program, deserving of highest priority, has been slowed because of a lack of funding while monies were wasted on futile "eradication" programs. Valuable time was lost while immense economic and ecological damage occurred. Now the Imperial Valley cotton industry is at the same crisis point as Texas's Rio Grande Valley. And the same question arises: Can rational insect control be invoked before there is complete economic collapse?

The history of cotton insect control has been marked by waste, misery, death, and destruction. Yet we seem to have learned little from this pattern of disaster. The growers and entomologists of Central America, northeastern Mexico, and the Rio Grande and Imperial valleys apparently did not learn much from the experience of the Cañete Valley. Now in Australia a newly developing cotton industry seems to be repeating the same mistake. The Australians have spread an insecticidal blanket and already the symptoms of the treadmill are beginning to appear.

And this entomological myopia extends beyond cotton. Earlier this year there was actually in motion a program to "eradicate" the fire ant from the southeastern United States. This program envisaged the broadcast distribution of an organochlorine insecticide, Mirex, over every acre of nine states, a total of 120 million acres. The campaign was to span 12 years and cost at least $200 million.

There was not the slightest chance that the goal of eradication could have been attained. The same genetic and ecological feedback that has repeatedly defeated chemical control of cotton pests doomed the fire ant program from the start. Yet, government pest control specialists and politicians insisted it be tried. Only the vigorous counteraction of conservationists, environmentalists, and a handful of respected entomologists prevented the full implementation of this program, which was curtailed, but not abandoned. Even now, Mirex is being widely dispersed through the environment at great expense. And in the end, the program will fail.

What fools we are! Insects are our most successful rivals for the bounty of the earth. Yet when we attempt to suppress them, we insist on playing into their strength. As we continue our folly, the repeated triumphs of these little beasts may well be the first faint indicators of our own demise.

The larva of a beet armyworm, *Spodoptera exigua*, a secondary cotton pest, is preyed upon by other insects. Assassin bugs, *Zelus renardii*, above, and *Nabis americoferus*, below, feed on this pest, as does the larva of a lacewing, *Chrysopa carnea*, at right.

An Invasion of Sharks

Darkness, currents, and the scent of food brought sharks from miles around. They hunted with the deadly, machinelike efficiency they have developed over 200 million years

by Edward S. Hodgson

On the night of the August full oon, an ancient ritual was renacted with special intensity in the imini lagoon. An early symptom f the event could be detected when large nurse shark, which had reained immobile for several hours nder a limestone outcropping, bean to rock gently from side to side. bserved casually, this motion ould easily have been mistaken for happenstance effect of local water urrents upon the inert body of the hark. Within a few minutes, hower, a subtle modification develped in the rocking motion, betrayng its true origin.

The shark's head began making omentary shifts to one side. Each ime this happened, portions of the nimal's trunk duplicated the moveent, starting behind the gills and rogressing toward the tail. Gradually, as if a sequence of motors was being activated, the shark's entire body was thrown into graceful S-curved undulations, the basic pattern of swimming that underlies water locomotion in all backboned animals. Still the shark did not move from its shelter.

Delicately, the broad pectoral fins pushed down against the bottom sand, raising the animal's head several inches. With its big snout reared against the direction of the strongest water current, the nurse shark resembled a giant tadpole alert to events upstream. The gill openings, which had been expanding and closing in a regular rhythm, gave a sudden extra beat and then closed down, their edges smooth along the side of the body. Simultaneously, the undulations of the shark's trunk became more powerful, pushing the body forward into the current. With regular gill action resumed, and waves of muscle contraction passing steadily along its length, the shark began to swim up the channel of the lagoon.

Nothing disturbed the water's surface. In the bright moonlight three other nurse sharks and a large lemon shark could be seen gliding underneath our skiff. The silent movement of the sharks, each following the same course into the lagoon, gave an eerie impression of inexorable purposefulness.

From ashore, the faint sounds of drumbeats and bursts of distant shouting reached our otherwise quiet observation post. A party was in full swing, celebrating the day's triumphs in a local fishing tournament. That was the culmination of a hunt by humans, which had been

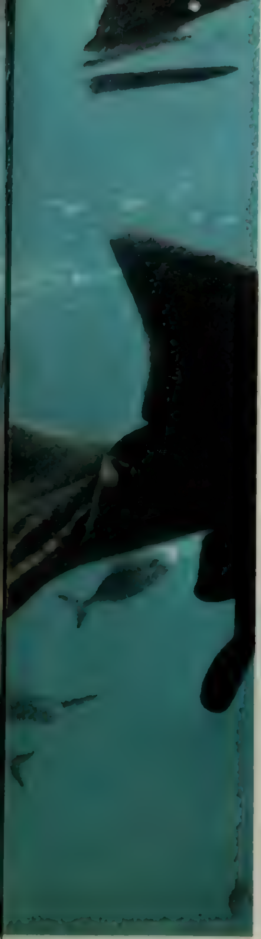
A nurse shark attacks the source of an odor trail it has followed across a pen in the Bimini lagoon. The odor came from amines, a meat breakdown product.

emon shark, stimulated the smell of food. hes indiscriminately surface debris and bubbles as it nears source of the scent.

completed within its time allotment for the day. Now a more efficient hunt, refined during a 200-million-year history, was getting under way. Floating away from the festivities of our own species, concentrating upon the graceful movements of the sharks beneath our boat, it was difficult to resist the impression of being transported far from civilization back into some primordial era.

While nightly activation and influx of sharks is a routine phenomenon around many islands in tropical and subtropical seas, the invasion of the lagoon between the three islands of the Bimini group was particularly impressive that night. As many as seven sharks, ranging from four to ten feet in length, could be observed at one time below us. Dorsal fins and tails of numerous smaller sharks agitated the surface of the shallow water over adjacent sand flats. The total number of sharks approaching the channel must have been well over one hundred. Most of those that could be seen clearly enough to identify were nurse sharks or lemon sharks, the two species most commonly encountered in the local inshore areas, and the ones upon which we concentrated detailed observations. In seeking explanations for their activities on the evening described, I hoped to add to our understanding of the sensitive mechanisms involved in orientation, feeding, and attack by these prominent inhabitants of the tropical marine environment.

The behavior being displayed appeared to be influenced by an unusual coincidence of several factors. Onset of darkness was certainly one major influence, at least for the nurse sharks. They typically spend the daylight hours in shade, often sheltered under ledges or in caves from which they depart at dusk. Lemon sharks, on the other hand, may be observed swimming at all hours. Although they may rest on the bottom for short periods, the larger specimens must move almost continually, mouths held slightly open, to provide an adequate flow of water over their gills. But both



Even in a feeding frenzy, as here, nurse and lemon sharks act differently. The nurse constantly thrashes about and works its jaws, while the lemon snaps only at specific objects.

With no stimulant to direct them, lemon sharks follow a basic circling pattern in a 40- by 80-foot observation pen.

A lemon shark rubs its side against the bottom to dislodge a remora, as smaller fish scatter. During a feeding frenzy a lemon shark may try, usually in vain, to catch the small fish.

lemon and nurse sharks exhibit a quickening of activity in darkness, and that doubtless contributed to the timing of events in the Bimini lagoon.

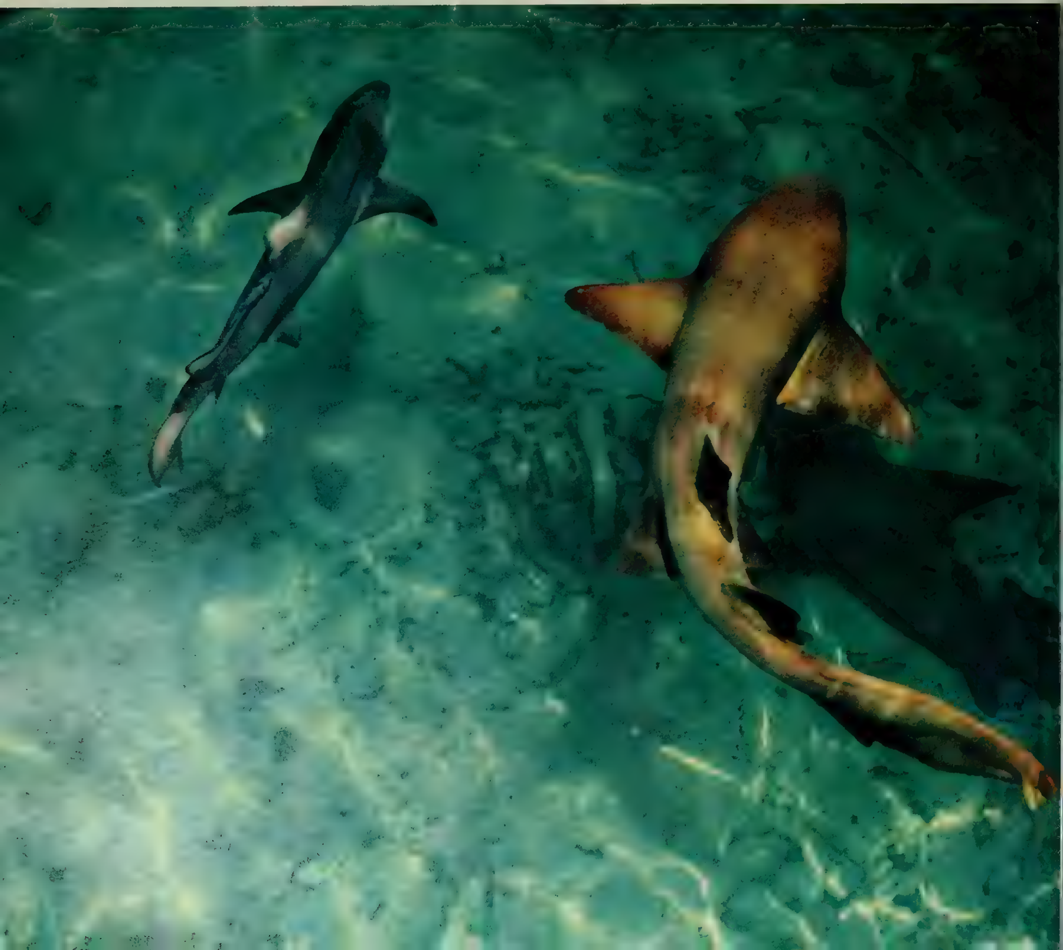
Tide played a more subtle role. Around that full moon, tidal fluctuations at Bimini measured nearly a foot and a half greater than usual. This meant that the water currents were especially strong as larger volumes of water moved into and out of the lagoon. Any shark roused to activity that August evening no doubt encountered a strong outgoing tidal current. The usual tendency to swim against a water current would have oriented the animal upstream into the lagoon. This is another reaction that assists the flow of water over the gills, as well as maximizing exposure to any odors carried in the current.

The attractiveness of the waterborne odors coming from the lagoon that evening must have been exceptional. Piles of fish, or the remains thereof, had been dumped from the docks as soon as their weights were tallied in the fishing tournament. A 570-pound mako shark was being butchered in the shallow water edging one marina. Drippings from freshly washed boat decks included a high concentration of fish scales and leftover tidbits of bait. Olfactory allure to all types of scavengers must have extended as far as the Gulf Stream.

Important as they undoubtedly were, all of these factors merely set the stage for the more refined mechanisms of orientation and feeding behavior in sharks. Once within the lagoon, each shark, depending upon its size, could swim throughout an area of two or three square miles, within which localized food sources had to be detected and approached if the shark's outpouring of energy was to be rewarded.

It was obvious that the sharks depended upon processes more exacting than chance encounters with food. Within 15 minutes after the shark invasion began at the entrance to the lagoon, two nurse sharks and one lemon shark converged upon the big chunk from the butchered mako. Fortunately, Shark behavior is studied from the platform near the left side of this 200-foot observing pen in the Bimini lagoon.

A lemon and a nurse shark swim side by side. The lemon typically flexes only its tail, while the nurse moves more of its body.



or ease of further observations, this ccurred near a pier of the Lerner Iarine Laboratory, half a mile from he harbor entrance. Sharks being naintained for studies at the labora- ory were agitated by the odors and eeding behavior outside their pens, nd from time to time other sharks ould be seen rendering clean-up ervices around each group of fish- ng boats in the harbor.

How do the aroused sharks reach he food so efficiently? The usual nswer is that they smell the food nd "follow their noses." Here gain, casual observation and gen- ralization cannot reveal important spects of the process, and in the ase of one species, the "ex- lanation" is quite misleading. In act, the lemon shark and the nurse harks that were tugging at the nako fin in the water had actually rrived at that slab of meat by quite ifferent methods, although smell layed a part in each case.

To understand a shark's behavior ithin a lagoon, it is necessary to neasure the sensory cues that the nimal encounters in that environ- nent. Water currents have to be de- rmined at various locations and tages of the tides, and the dimen- ions of diffusing olfactory corridors f smelly chemicals mapped. The hemicals emitted from potential ood substances have to be studied, that any molecules especially im- ortant as olfactory cues can be rec- gnized. Obviously, such detailed nowledge can only be obtained by estricting attention to a portion of he environment and by drawing pon the results of related labora- ory investigations.

Fortunately, my colleagues and I ad been able to assemble much of his background information during everal previous summers of work n Bimini. Robert Mathewson, resi- lent director of the Lerner Marine aboratory, had designed an elec- ronic blinker unit that could be ethered to the dorsal fin of a shark nd used to trace the animal's novements at night, when much of ts feeding occurred. Perry Gilbert, ow director of the Mote Marine aboratory, had shared with us the iscovery that certain breakdown roducts from meat, the amino cids and amines, had particularly powerful effects upon the nerve activity within sharks' brains. We had fenced in large areas of the Bimini lagoon—up to 200 feet in diameter—where we could observe the orientation and feeding behavior of sharks during normal tidal flows. An underwater television camera, located near the edge of the Gulf Stream, provided a superb opportunity to compare our findings with observations of completely free-ranging sharks. Considering the painstaking laboratory and field measurements that preceded the next round of behavioral observations, it is almost embarrassing to recall how quickly and thoroughly the sharks rendered our preconceptions obsolete.

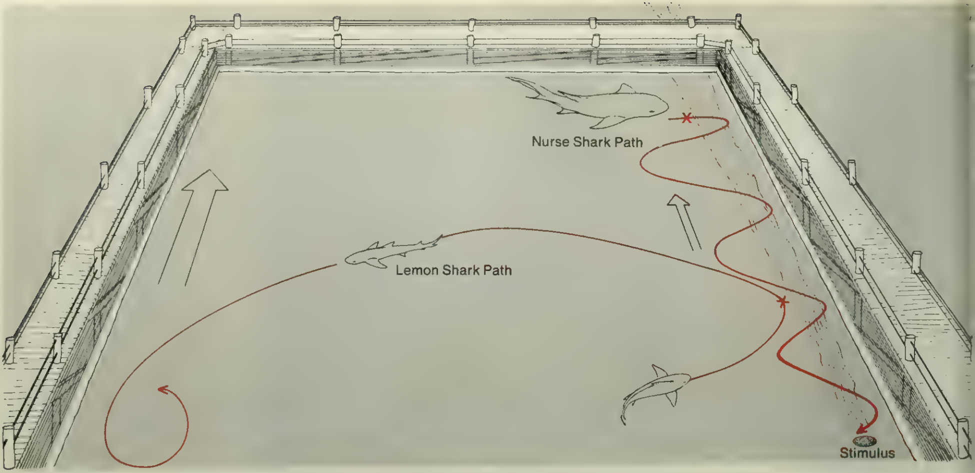
The very first shark observed in one of the lagoon pens surprised everyone. After this large lemon shark had settled into an approximately circular swimming pattern, a small quantity of homogenized tuna meat was allowed to stream into its pen. The fish extract was intentionally put into an area where currents were minimal, so that the smell would remain within the enclosure as long as possible and allow the shark every chance to "home-in" on the source. From previous testing with dyes, we knew just what area would be occupied by the olfactory corridor of tuna extract mixed with seawater.

As soon as the lemon shark cruised through this olfactory corridor, however, it swam to the opposite side of the pen and moved in tight circles in a "wrong" corner of the pen. Had the tuna extract actually repelled the shark, driving it forty feet from the target? We tested this by introducing the extract directly into the "wrong" corner and found the shark's behavior essentially unchanged. Since the shark now circled within the area of the stimulus, we could hardly conclude that it was repelled by the tuna.

Later, as it became clear that this was entirely typical behavior for lemon sharks, an explanation also emerged. The underwater smell merely triggered the [illegible] behavior; the lemon shark swam upstream in the strongest current. At the point where that current flowed into the enclosure, the shark swam in tight circles for about a minute, before resuming its basic cruising pattern. In the open sea, such a reaction would normally bring the shark close to an upcurrent source of stimulation. At close range, other cues, such as the sight of prey, might direct a final assault. It was only when the source of a chemical stimulus was separated from the strongest current flow that it became clear that the lemon shark was swimming up the current, rather than up the olfactory corridor. Yet this explanation in the case of the lemon shark raised other questions. An animal immersed in a uniform water current requires additional cues for orienting upstream. If it has no other frame of reference, the animal has no way of knowing it is in a current at all. During the daytime, lemon sharks might easily depend upon the sight of the sea bottom in the relatively shallow areas they normally inhabit. But what happens on a dark night?

Photographs of shark blinker trails at night quickly revealed that when stimulated by food extracts, lemon sharks oriented to water currents even on moonless nights. When the source of an olfactory corridor was removed from the strongest current, these sharks typically swam past the lure, completely overshooting it. Later they would sometimes encounter the chemical, but only after abandoning their attempts to swim upcurrent and resuming the basic pattern of swimming in circles. It appeared that their successes were really chance encounters with the chemical stimulus, hardly adequate to account for the hunting efficiency of the sharks under normal circumstances. Consequently, there is still some mystery about the lemon shark's orientation.

One question is how the animal closes in on its prey when the prey is not directly upcurrent. Another is exactly how the shark senses the current itself. Minute differences of water flow or turbulence on both sides of its body, detected by pressure-sensitive receptors along its lateral line, may be crucial for orienting upstream or for detecting nearby prey at night. This, however, needs much further investigation.

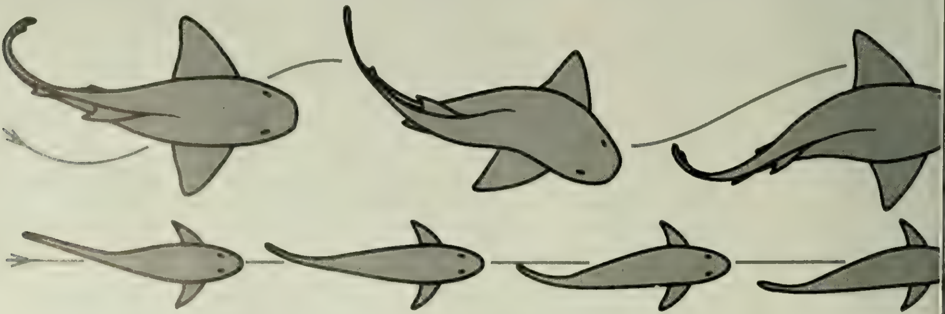


Lemon and nurse sharks react very differently to the smell of food in the water. Here a current flowing through a pen is stronger on the left side. When the lemon shark smells food, at point X, it immediately swims up into the strongest current, missing the food completely. The nurse shark swims up the odor trail, moving from side to side as it homes in.

Meanwhile, the nurse sharks surprised us in quite a different way. These animals had appeared to be slow, groveling feeders. Exposed to a stream of fish extract, however, nurse sharks swam powerfully and unhesitatingly up an olfactory trail. It proved impossible to trick these sharks by putting the bait in an area of relatively slow water movements, and when the sharks towed a flash unit at night, the blinker trails left no doubt about the secret of their success. They swam in a zigzag pattern, back and forth across the olfactory corridor, evidently comparing concentrations of the stimulating chemicals at different positions along the route. This method worked so well that whenever lemon sharks and nurse sharks were observed together, the latter typically outperformed the competition, reaching the source of the smell while the lemon sharks were still milling around in the distance The behavior of the nurse sharks even suggested a significant capacity for learning the locations of food, for if a fish extract was released several times from the same spot, the shark's side-to-side sampling movements decreased with each test, while the speed of reaching the source increased.

I was curious to know whether the amino acids and amines, which had modified the brain waves o sharks in our laboratory studies could trigger normal feeding behavior. By substituting a mixture o these pure chemicals for the fish extracts, we found that the sharks reacted to the mixed chemicals essentially as they had to the homogenized food. One test of thi point provided the only really alarming incident that occurred dur

Sketches indicate differences in swimming motions between nurse shark, top row, and lemon shark, bottom.



ing all our hours of shark watching.

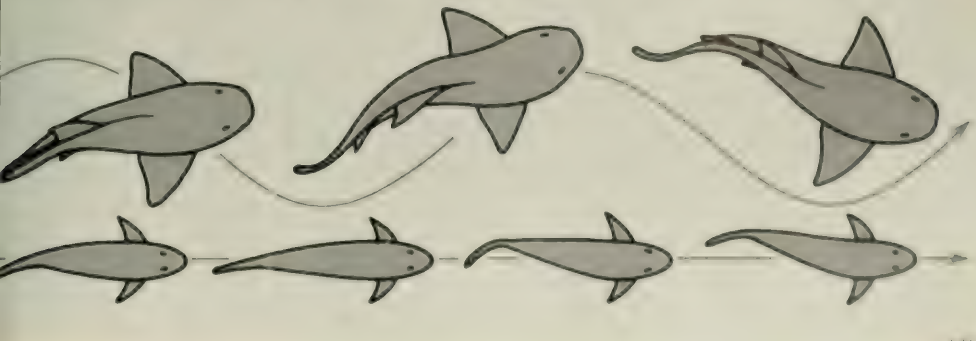
Prior to squirting any chemicals into a shark pen, it was necessary to fasten the end of the injection tube at whatever position was appropriate for the water currents at the time. On one occasion, after attending to this simple underwater job, I took a little extra time to concentrate upon adjusting the camera in my observation cage. Neither I, nor the patient assistant who waited on the dock with a stimulus bottle, paid much attention to the sharks in the enclosure because we expected half an hour to elapse before the tide became right for our observations. Suddenly, a guttural slurp assailed my right ear, at once deafening me and prompting a convulsive leap toward the surface. Looking back from halfway up a ladder to the dock, I was startled to find a ten-foot nurse shark sucking violently upon the end of the chemical outlet tube, which had been located only a few inches from my head. Evidently, even before any amines were intentionally passed through the tube, a trace of the chemicals had diffused from the orifice. That was all it took for this olfactory sophisticate to zero in on the source and give an ear-splitting demonstration of the appropriateness of its common name!

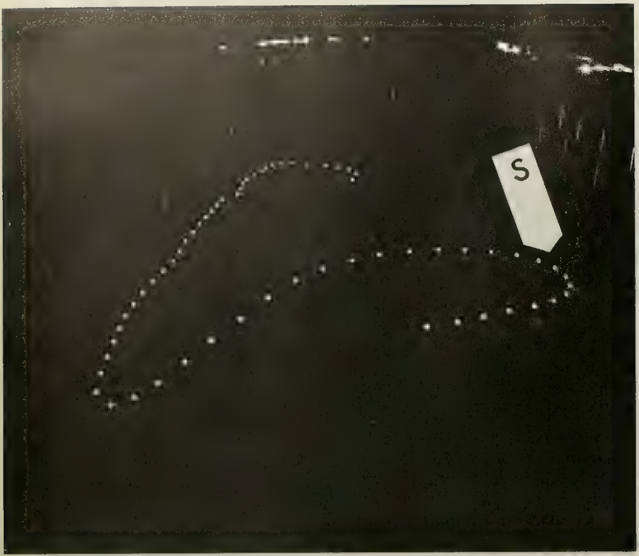
Less dramatic but equally revealing insights came while watching the sharks underwater. Adaptations for their particular orientation methods were obviously built into the body structure and movements of each species. The graceful flexibility of the swimming nurse shark automatically facilitates the sideways head movements essential for scanning stimulus intensities along an odor trail. Approaching an olfactory lure, a nurse shark may arc its body back and forth through three-quarters of a complete circle. By comparison, the swimming lemon shark seems almost stiff, with most of its transverse movements confined to the tail. The nearly straight track of its streamlined head, however, certainly minimizes the water resistance of a swimming lemon shark, an important advantage to an animal that often persists in swimming against the strongest currents in its vicinity.

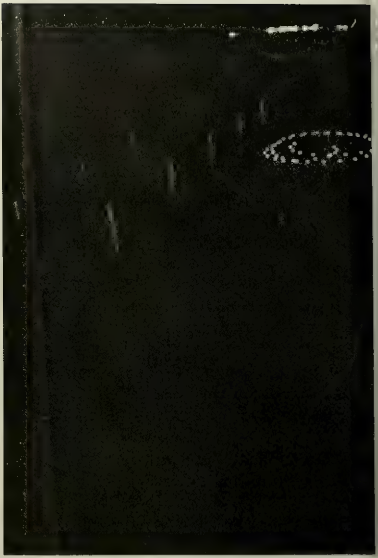
Once the hungry sharks arrived within a high concentration of amines or food extracts and a so-called feeding frenzy had set in, additional differences between the species appeared. Nurse sharks persisted in thrashing about, working their jaws and sucking wherever the chemical stimuli were strongest. Lemon sharks, however, snapped their jaws only when some object floated nearby in the water. Virtually any introduced object, from a piece of seaweed to a rubber hose or a patch of bubbles on the surface, became fair game for a frenzied lemon shark. Occasionally, one of the lemons even went after the small fish that were its close swimming companions, although these agile little fish (mostly jacks) invariably outmaneuvered the shark. Unless food was encountered, however, lemon sharks quickly abandoned the area to the nurse sharks and jacks, for which smell alone appeared to be sufficient motivation.

It was still an open question whether completely free-swimming sharks would orient by the same mechanisms. To find out, perforated bottles containing a mixture of amino acids and amines were positioned in front of the television camera situated offshore under 65 feet of water. Despite every confidence in the expert divers who daily carried down the stimulus bottles, this maneuver always produced considerable suspense. A highly successful result from the point of view of a shark-watcher at the indoor television screen might be distinctly uncomfortable for a diver swimming in the middle of his own shark bait. Fortunately, diffusion from the bottles was slow and the divers never saw a shark near the camera while they were working. Nor did any sharks appear on the television screen during the first six days of testing. Either the water currents were too weak to carry the chemicals beyond the strictly local fish population or sudden squalls churned up the bottom so that nothing at all could be seen.

Our luck changed on the next clear day, when a strong current was running past the TV camera. Suddenly, the fish that usually frequented the chemical release site all disappeared from view. A big lemon shark slid past the camera, headed upstream, and swam right past the stimulus bottle and out of the television picture. Of course this behavior might have been predicted from our observations of lemon sharks in the confined areas of the lagoon, but it was so startling to watch it happening in the open ocean that nobody in the television room remembered to take photographs. Before the various expressions of regret diminished to a roar, however, a group of three sharp-nosed sharks approached the stimulus bottle, again from the







A blinker tied to a lemon shark shows it scenting food at left, turning into the current and, in the middle picture, circling vainly in the far corner of the pen. In the third picture, a nurse shark crisscrosses the trail until it reaches the source. At right, a lemon shark turns on a small jack.

down-current side, adding another species to our records. The sharpnoses, too, swam off upcurrent, but one circled back around the bottle just as Bob Mathewson hit the trigger on a motorized camera to document the occasion. Discounting "repeaters," at least eleven sharks, members of three different species, reacted to the chemicals in open sea tests that day. It was hardly a reenactment of the night of the August full moon, but the observations left no doubt that we had produced a small-scale shark invasion of that area. Clearly, the behavior so extensively analyzed in the lagoon actually did go on in the open sea.

As the next full moon approached, I watched for signs of another mass shark invasion of the Bimini lagoon. But it never came. No doubt the coincidence of so many powerful stimuli was lacking. On a lesser scale, however, the ritual of arousal and foraging by the sharks went on every night.

My own shark-watching habits, too, had been modified during the passage of time. Now I found myself appraising the gill beats and trunk movements of nurse sharks to judge whether they were hunting or merely cruising. Lemon sharks impressed me as useful current and tide indicators. The sudden desertion of a shark by its companion fish suggested a chemical stimulus nearby, and if it happened to be a lemon shark, I automatically looked to see what could be distracting it from purely current-following behavior. Always, there were further questions: What arousal mechanism activates the animals at dusk? What other chemical cues direct the hunt? How might the fish's lateral line detect nearby objects at night? How quickly do the sharks become adapted and insensitive to odors? Happily, the unknowns are still among the most intriguing features of the story.

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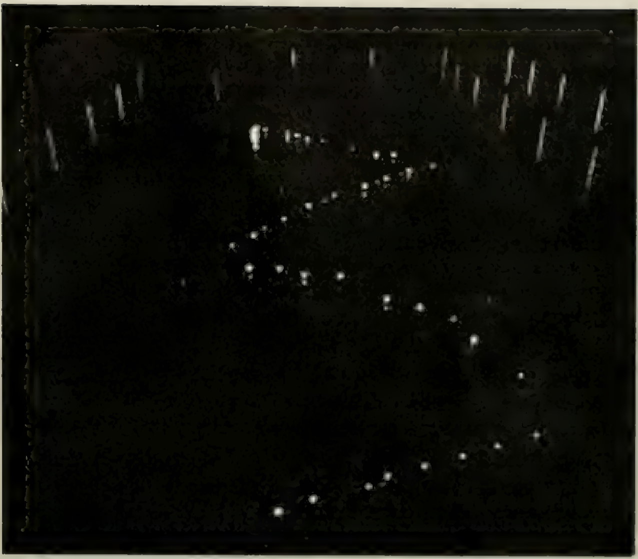

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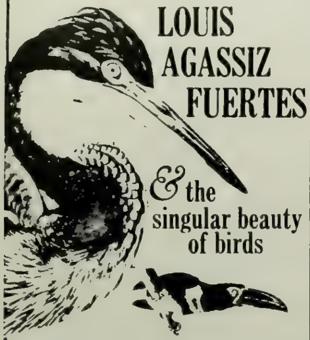

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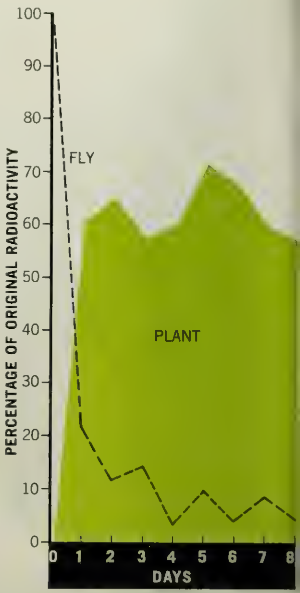
Fly in the Sundew

Continued from page 85

metabolizing, growing cells quickly accumulate a large portion of the radiolabeled nutrient material. Only later does it continue to spread through the plant and appear in any significant concentration in the other leaves and in the flower if there is one. From the autoradiogram produced when these fed plant parts were laid on a sheet of film, it is possible to see which parts of the plant have the higher concentrations of radioactivity: that is, which have been made from material assimilated from the insect and utilized by the plant in its growth.

To emphasize the role of the gland and the tentacle in the digestion and absorption of material from outside sources, a control experiment was performed in which a radioactive insect was fed to a leaf from which the tentacles had been clipped. The distribution of the radioactivity in this case was extremely different. A scan of the amount and rate of radioactivity lost by the radiolabeled fly on the clipped leaf compared to that lost by the fly placed on the gland of the normal leaf demonstrated the essential role of the tentacle. In 24 hours the clipped leaf took up only 12 percent of the fly's radioactivity, compared to the 80 percent taken up by the normal leaf in the same period of time. Subsequently, in the normal leaf there was a further uptake of radioactivity (about 15 percent), while the clipped leaf exhibited no further gain for three days, after which only 6 percent more was absorbed. One would imagine that by this time there would have been considerable opportunity for the insect's own enzymes to have broken down its tissues, permitting material to diffuse into the leaf. Such a process could account for the small amount taken up by the clipped leaf.

The smallness of this amount strongly suggests that all of the absorption that takes place on the fed leaf does so through the glands at the ends of the tentacles. Recent scanning electron micrographs by Barbara Panessa of New York University have revealed the presence of glandlike structures on the leaf surface proper. But even if absorption can take place through these, apparently digestion cannot. If



These curves show the declin of radioactivity in a fruit fly and the increase of radioactivity in a sundew with the passage of time.

these surface glands were capable o digestion, there would have bee far more absorption of the fruit fl in direct contact with the clippe leaf. That the tentacle's digestio and assimilation mechanism is a effective one becomes obvious whe on realizes that all but 6.3 percen of the original radioactivity in th fly is assimilated by the plant. Thi apparently indigestible remainder i probably radioactive phosphoru that has been incorporated into th exoskeleton of the insect.

The results of these experiment confirm that, by the practice of ca nivory, these highly specialize plants have acquired for themselve a source of nitrogen for their ow growth and development in th midst of an environment that is e tremely poor in this element. B this means they have been able t extend themselves into an ecolog cal niche that otherwise would n have been available to them.

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horses are fettered and let loose to graze "the long acre of Widow Green" (the roadside) or slipped into the meadow of an unsuspecting farmer. Some of the teen-agers may move off to the pictures if a cinema is close at hand. The other tinkers gather around the fireside to recount the adventures of the day, perhaps naming the *buffaly shams* (country folk) they have outwitted. In historic mood, they might recount the cleverness of their grandsires in pretending to strike silver coins from solder by means of a mysterious *gladar box*, thus duping greedy farmers into advancing money to subsidize a homemade mint.

Invariably they will ask passersby for the time, not because they are unduly concerned about the dictates of the clock, but as a subterfuge to find out whether it is friend or foe that passes. If foe, a boy is sent scurrying across the fields to drive out the tinkers' animals that may be grazing on a farmer's land. When the sun has set they retire to bunks in the caravans, with the spillover accommodated in the camps, to sleep the sleep of the just.

Summer morning finds them stripped to the waist and standing barefoot in a stream, sloshing water on their faces and bodies and obviously overjoyed at the prospect of an adventurous day before them. At times when traveling through the countryside at dawn I have seen naked two- or three-year-old tinker children rolling out of camps to play like fox pups on the asphalt of a roadway.

A harsh winter brings terrifying problems and, on occasion, distress in its most acute form. Really cold weather, although rare, is hard on the wanderers. But more deadly is the dampness of the Irish climate, which begets respiratory afflictions of all sorts. This accounts most for the high mortality rate among tinkers. (The infant mortality rate is unusually high, since many young couples start their married life with no better dwelling than a tent. A 1960 census noted that of 1,124 children born alive in the preceding ten-year period, 85 died in the first year of life. In recent years this rate has been somewhat reduced but it is still far above the national average.)

I shall long remember the blast of fetid air that hit my nostrils when I opened up a caravan in which seven or eight children, the eldest a girl of about nine, had been shut up for a period of weeks during an unusually harsh period of frosty weather. Both parents were ill and in a hospital. The floor boards of the caravan were coated with stiffened diarrhea and glossy with frozen urine. I shall also retain for many years to come the memory of holding the sweating hand of a tinker mother as she lay dying in a sanatorium, begging me to take care of her children after her death. This I fulfilled in some measure.

I shall never forget my fear in a storm-lashed encampment under great groaning trees with floodwater seething around the hooves of terrified horses and the light caravans rocking crazily in a powerful wind. At the height of this near-disaster I counted twenty-nine children crouched in a sea of mud, their puny shoulders to the spokes as they fought to push the vehicles out from under the wildly thrashing branches overhead, while their elders tried to harness the horses to the caravans. It is no wonder that toward the end of winter, after living for months on raw nerves, tinkers are highly explosive, and one must approach them with extreme caution at this time. But come March and April their spirits begin to heal in the livelier air of the Irish spring.

Needless to say, the traveling people pose a problem for the Irish government and for local authorities. On the government level, the problem has been faced with generosity and understanding. As a result of the report of a special commission, the government of the Republic has promised full compensation to any local authority willing to help itinerants in the matter of housing. The Irish Council for Itinerant Settlement, with its various local branches under the national leadership of dedicated men, has done remarkable work in directing the conscience of the Irish people.

As a first step, caravan sites and *tigíns* ("little houses") have been set up in different localities with the promise of well-built homes to fol-

low, a promise that is in some me
sure being fulfilled. Labré Par
named for St. Benedict Josep
Labré, an Italian traveler who spe
a great part of his life walking fro
shrine to shrine, is situated on th
eastern industrial outskirts of Dul
lin, and houses 39 tinker familie
Eighty children are enrolled in i
school.

Trouble sometimes arises whe
prospective neighbors, who feel s
cially threatened by the tinker
proximity, react blindly and wi
unreasoning hatred. Tinkers ha
been called vermin and burned o
and scared off with firearms. True
the saying, "The outcast's fear
society is exceeded only by society
fear of the outcast."

With the establishment of pe
manent and semipermanent hou

Tinker home life centers around the campfire, top left, where a man might pause to dip into a pot of stew kept warm in the coals. Above, with feats of strength and a carnival spirit, two traveling men hope to wheedle shillings from townsfolk.
Left, kitchen in a truck.

inker weddings. while joyous
ffairs. nevertheless reflect
rict tribal law. After a
rief courtship. this young
ride. left. like most tinker
ewlyweds. will start her
arried life on the road. Right.
small boy with a prized
ossession. a harmonica.

z. many tinker children—whose
mal education hitherto consisted
a few weeks attendance prior to
eiving First Holy Communion
l a few still more cursory days
ore receiving Confirmation—are
w offered the chance to attend
ool regularly. These children are
ther more nor less intelligent
n the average child of settled
ents—with the single proviso
t, since environment plays a ma-
part in the development of a
ld's motivation. their lack of an
vironment favorable to formal
ication is somewhat of a handi-
. But they are considerably more
f-reliant, resilient, and adaptable
n the child of fixed residence.

As a teacher. I have had the rare
ortunity to observe the impact
formal education on a young
d typical of those that for gener-
ons have never been exposed to
educational experience. It is
rtwarming to see a boy of nine
d the newspapers (the court
es especially) to illiterate parents
olly entranced at the scholarship
their son. It is rewarding to ob-
ve a traveling child express his
ion of the world on paper with brush and poster paints (in their garish clothing and in the decoration of their caravans. tinkers have always used color lavishly), or to watch him listen to a lecture on Flemish art. For me the pinnacle of pride and pleasure was reached on the occasion of the annual First Communion Mass when. in answer to my signal. a red-headed tinker boy of nine mounted a polished chair in the sanctuary, gripped the lectern, and read for the congregation the Epistle and responsorial Psalm in tones that echoed the pristine beauty of the world.

Here and there in Ireland today a few children born of the roads are now moving toward the equivalent of graduation in the American sense of the word. In the view of the Irish social worker, it is formal education that provides the greatest hope for these youngsters. For example, through education it is possible to convey, completely by inference, to the tinker child that begging is a badge of shame and slavery. If the child somehow transfers this awareness to his parents, the abuse can be brought to an end.

The mind of the traveler is convolute. and it is trite to say that the "traveler wears many masks." He can be cunning. emotional, mercurial. primitive. generous. and loving. Family loyalty is intense. To be present at a tinker funeral (mourners often travel long distances, even from England. to attend) is to see an unrestrained human expression of grief at the loss of a loved one. Men and women cry unabashedly and hurtle themselves at the open grave, bystanders writhe in a stylized manner. and women tear at their matted hair.

All tinkers are Roman Catholics and attend mass as often as possible. Oldsters tend to hang around the doorway of the church, but the younger folk, now wearing attractive bright clothes, move boldly into the nave. They experience their faith in simple terms of love and fear: love of the shining heavens of the hereafter. where the seemingly never-ending struggle to keep body and soul together will finally be resolved in eternal bliss and fear of hell and "the clock that ticks forever."

Tinkers have a strict moral code. They tend to marry at the onset of

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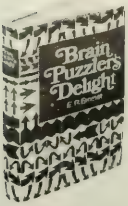

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nubility, and courtships are treated with suspicion. The story, probably apocryphal, is told of an old priest leaving an encampment after hearing confessions and murmuring to himself in disbelief, "No fornication!" If a young man from one clan takes a girl from another out of the circle of the campfire and into the darkness, the tribal law is inflexible. They are to marry or risk a bloody clan feud. If the pair are related "within the forbidden degrees of kindred," as indeed they often are, they will seek out in a remote parish a priest traditionally well disposed toward them and ask him to write to the bishop for a dispensation allowing them to marry. "A letter to separate our blood," is the term used.

The church wedding itself, often held after one of the great fairs, is an ebullient event that can be intensely moving. Sometimes the celebration will spill over onto the roadside to include the passersby in a tide of infectious hilarity and joy. When everyone has drunk his fill, the young couple move off in a flat cart loaded with the bare necessities of life to make the first "bed of honor" on a quiet roadside. Thus begins another family on the roads of Ireland.

But all this is changing. The tinker of fiction, so beloved by Irish writers, Synge in particular, is undergoing a change. Some tinkers show marked resilience—shuttling back and forth between the more remote parts of Ireland and the cities of Britain, taking factory jobs for a while, or undertaking contracts for black-topping streets in Derry and Belfast. Quite a few of the more adaptable tinkers are amateur antique dealers; they scour the Irish countryside for old carriage lamps, outmoded vehicles of all kinds, odd pieces of furniture, old skillets or pots, and numerous other articles that defy nomenclature. These they sell at a profit. Some tinkers who have become dealers set up impromptu antique shops on the roadside to attract the attention of tourists.

Nowadays, most of the traveling people move into the towns in winter, even venturing into the outskirts of Dublin. Parking their caravans in the suburbs, they penetrate on foot into such fashionable parts of the city as St. Stephen's Green or

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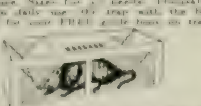

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Merrion Square, places as remote from their natural hedgerow environment as can be imagined. They know the tourist "runs," the hospitable kitchens of convents, the side doors of those hotels where the chefs are sympathetic, and especially the back doors of the newly built tract homes where a young suburban mother will be touched by the sight of the infant in arms.

Tinkers employ the psychology of begging in all its nicety. A young man chatting with his girl friend is particularly vulnerable, as is a tourist who has never before come face to face with a person possessing such powers of wheedling. Tinkers are also quick to spot a young priest anxious to live up to the standard of charity implied by his cloth.

I know one young tinker rascal who bragged that he lived in high style in England by moving from presbytery to presbytery, tearfully telling the priests that he sorely needed the fare to return to Ireland to see his mother on her deathbed. To offset this, I have known tinkers who paid off their contracted debts to the last penny, to the amazement of their creditors who had written off the amount many years before.

As I view him, the tinker on the Irish roads (I have avoided the word *itinerant* as much as possible, as I reckon it one of false elegance) is one of the outer ramparts of individual liberty. He continues to vouch for the wit, the resourcefulness, and the versatility of man, since every dawn brings him the problem of accumulating enough food to be alive at sunset. And, just as the writer of fiction at times tests the vaguely defined area on the edges of consciousness and sanity, so also in the life of the tinker there is that which tests the edge of physical living. To some extent he exemplifies what man can endure under conditions of extreme hostility.

Mankind has as many layers as an onion, and when all these layers are peeled off, the core is tinker or gypsy; the traveler is in me, in you, in everyman. Yet, compared with the tinker we are lapdogs by the parlor fireside quivering in commingled fear and ecstasy when, through the sound of the gusting storm outside, we hear the baying of wild dogs running free by the light of the moon.

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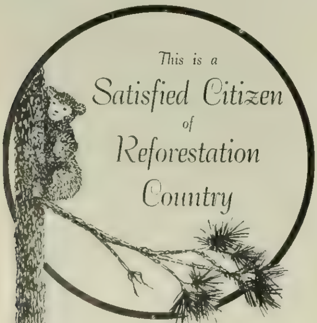

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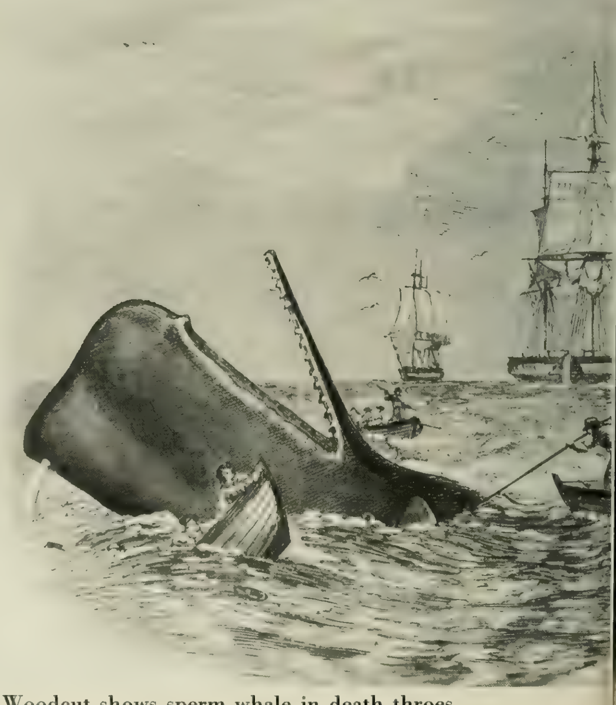
Books in Review

"But the Killing Continued

by Scott McVay

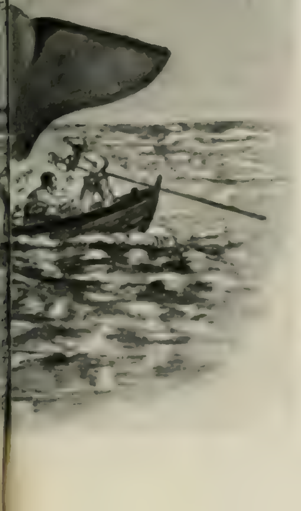
THE BLUE WHALE, by George L. Small. *Columbia University Press, $9.95; 248 pp., illus.*

In *Slaughterhouse-Five or The Children's Crusade*, Kurt Vonnegut's book about the bombing of Dresden where 135,000 persons perished—a book t took him twenty-five years to get out his craw because he did not know h to write about such violence—there i refrain, a phrase that begins to gat terrible meaning as the seemingly nocuous story unfolds. Whenever



Woodcut shows sperm whale in death throes.

rutish or vicious act occurs, so brutal
nd vicious that no commentary is pos-
ble, Vonnegut invokes the refrain,
So it goes." At those moments, one
onders if we are going to make it, or if
l the ego-tripping is not finally going
do us in.



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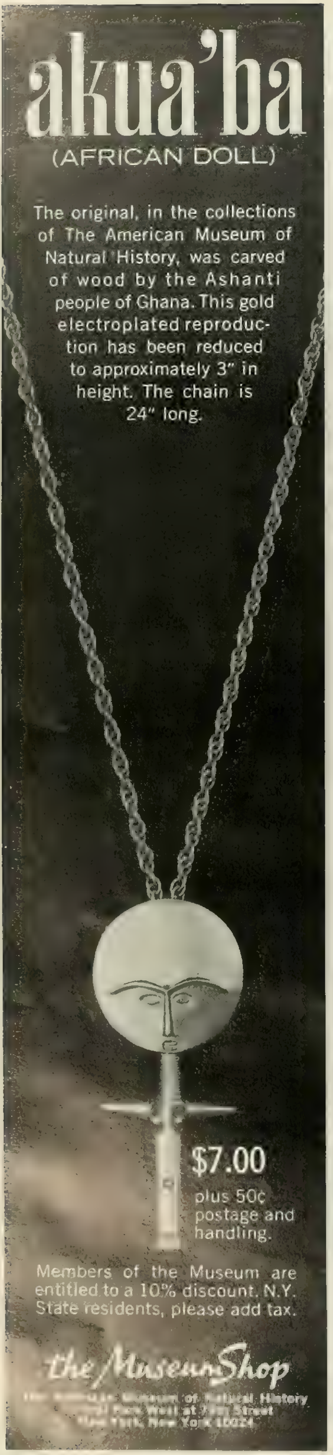
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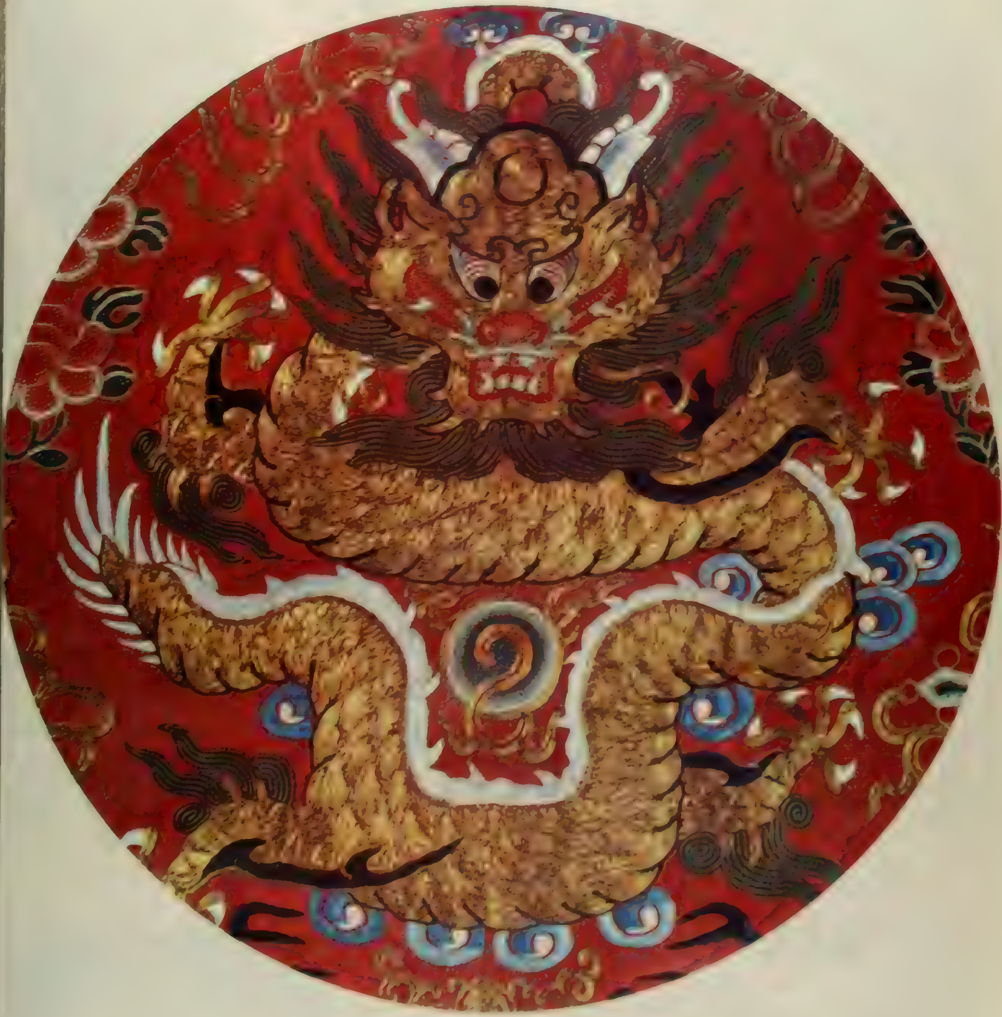
A similar refrain, less subtle, more direct, permeates George Small's book, *The Blue Whale.* It is, "But the killing continued." We are told, for example, that "international conferences were held and treaties were ratified to protect the whales. But the killing continued." The International Whaling Commission met again. *But the killing continued.* During the past half-century more than 2,000,000 whales have been killed, and the only respite the whales have known was the period when the primary resources of Europe, America, and Japan were engaged in World War II, which involved atrocities on a scale not known before and which may be recalled by saying the names of places: Auschwitz, Pearl Harbor, Dresden, Hiroshima. *So it goes.*

> **"The tragedy of the blue whale is the reflection of an even greater one, that of man himself. What is the nature of a species that knowingly and without good reason exterminates another? How long will man persist in the belief that he is the master of this Earth rather than one of its guests? When will he learn that he is but one form of life among countless thousands, each one of which is in some way related to and dependent on all others? How long can he survive if he does not? It might be easier for man to acknowledge his dependence on other life forms if he could recognize his kinship with them. . . . Survival chances for the human race will be greatly enhanced when man concedes to the Earth and all its life forms the right to exist that he wants for himself. The only homage he can now pay to the blue whale is to learn the lessons of dependence on and kinship with all life. If he does not learn them the great blue whale will have died in vain—having taught nothing to his only mortal enemy."**
>
> GEORGE L. SMALL
> *The Blue Whale*

In contrast to much whale writing, *The Blue Whale* is not a rehash of material published elsewhere. With the thoroughness of a scholar determined to get a complete story, Small has pored over the verbatim record of the Inte national Whaling Commission. Ever graph and chart shows yet another vie of the encompassing tragedy of the blu whale. Not only has Small uncovere scores of original sources, especially i Norway, but he has also integrated th material with the grace of an authorit steeped in his subject. This book is th painstaking work of years, a loved l bor, and it shows.

This does not mean that gnat-picke may not find statements to argue wit For example, the word *extinction* is o casionally used loosely in the bo While the blue whale population h dropped to commercial insignifican we do not know if its stocks are n too small to be biologically viable. T threat of biological extinction is r enough, yet the shattering, indisputa fact is that as a result of whaling m practice, the blue whale, "the larg animal known to have lived on land sea since the beginning of time,"

Costumes of the East



A fascinating history of the costumes of Eastern civilizations—from Turkey to Japan, from Palestine to Siberia. Walter A. Fairservis, Jr., anthropologist ith The American Museum of Natural History, describes in 160 pages (67 in full color) the costumes, their functions, and their relation to culture and climate.

The costumes, some of which were featured in the November 1971 issue of NATURAL HISTORY MAGAZINE, are displayed in a special exhibit at The American Museum.

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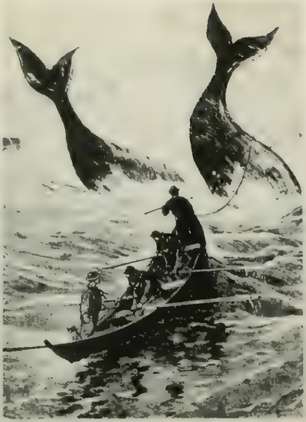

An 1885 engraving of the capture of two large whales.

longer plays a significant role in the life of the oceans.

The only break for blue whales is that they travel farther south, closer to the pole, than the smaller, remaining, commercially hunted baleen whales. They seek the abundance of food found in the coldest waters of the antarctic summer, and that may be their salvation. The whalers seldom get that far south anymore. It isn't worth the trip. Besides, the blue whale is now "protected" by an amendment of the International Whaling Convention.

Small's prognosis is that the blue whale is finished, and he may be right. Every major stock of blue whales has been devastated. Yet we may dare to hope that his prediction of extinction for the blue whale proves erroneous. Although history is on the side of his prediction, it is possible that now that the blue whale is finally being protected, it will make a slow comeback over the next century. Perhaps only a moratorium on all whaling can breathe life into this thin hope. Or, at a minimum, an inspection plan that will make certain that the "protected" species are truly protected, not taken "in error" and listed in the day's log as something else.

Thanks to this book, we now know what happened to the blue whale. But we know not the blue whale. *So it goes.*

Scott McVay is chairman of the Committee on Whales of the Environmental Defense Fund and an administrator at Princeton University.

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More Reviews

NNOCENT KILLERS, by Hugo and Jane an Lawick-Goodall. *Houghton Mifflin o., $10.00; 222 pp., illus.*

nnocent Killers is an account of the social behavior of three very different ild African canids–the hyena, the ackal, and the wild dog. Its tone is riendly and informal, featuring the rek of a man and wife and their small hild through Africa in search of some f the most ferocious beasts that have ver been accurately described.

It's exciting and fun to read. Behavoral observations are detailed enough o be of scientific value, although they re not well quantified, for the study is n its early stages. It is a book about beavior not biology. It says little about he animals themselves, but it does phoograph them in action. The book treats hese three social canids in separate ections, intermixed with accounts of nfant care, floods, and other personal ouches that will make some readers ant to hasten to Africa.

The wild dog is a pack animal (pack ize from eight to ten) with a large ome range, perhaps more than a thouand square miles, and only a little evilence of territoriality. Like wolves, the rganization includes two hierarchies, ne among the males and one among he females. While tracking an animal, acks can run cross-country for three iles at thirty miles an hour, but their unts are only successful about a third f the time.

The golden jackal hunts and lives in airs and primarily eats small prey, uch as snakes and insects, but occaionally takes food as large as gazelle. he pairs mark their territory with both eces and urine and maintain it with owling. Like the wild dogs and wolves, he jackals hunt for their young and egurgitate food for them. One of their ore interesting meals is wildebeest aferbirth, which supplies a major part of heir diet in the appropriate season.

The hyenas offer a marked contrast o the other two. They live in much larger groups (called clans) which run in

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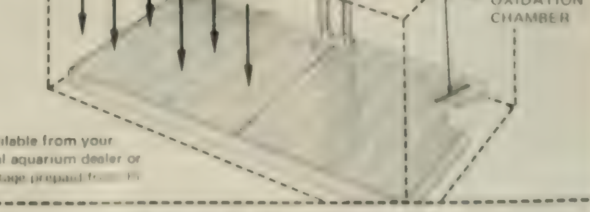
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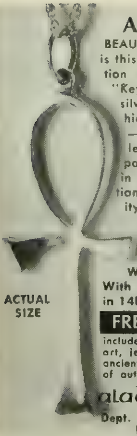

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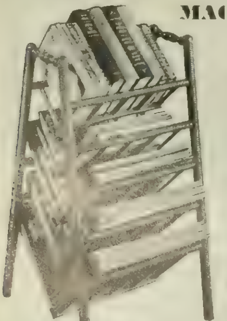

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size to about sixty. The clans, led by females, have well-defined territories that are ferociously defended, often resulting in the death of trespassers. These beasts suckle their offspring for eighteen months, during which time the young eat little solid food. The whole group seems to participate in the socialization process, with the young switching around among various dens and socializing in order to meet all the many members of their clan. These beasts are so bold and ferocious they are able to dine with lions.

Contrary to widely held opinion, all three of these species hunt and kill their own food much of the time—there is little scavenging in the total diet.

The personalized accounts of these animals is a pleasure I recommend to anyone interested in animal behavior.

JEROME H. WOOLPY
Earlham College

THE MEMOIRS OF CHIEF RED FOX, edited by Cash Asher. *McGraw-Hill Book Co., $6.95; 208 pp.*

Back in 1968, when Chief William Red Fox was a mere 97 years old, he came to my hometown in the Midwest. For hours he handed out recipes in a local supermarket while children gawked at the gaudy feathers and mothers marveled at the agility of the old Sioux, who periodically pranced and jangled a few steps to "demonstrate" Indian dances.

Three years later, McGraw-Hill has published *The Memoirs of Chief Red Fox* and the book has deservedly received critical acclaim. The Chief has been a charming and garrulous guest on TV talk shows for several years, and he has also appeared in more than a hundred Hollywood westerns. A show biz veteran, he started out with Buffalo Bill's Wild West Show and later traveled the rodeo circuit with the Miller Brothers 101 Ranch Wild West Show. During the Spanish-American War, he spent four years in the Navy. Chief Red Fox has been around.

If any one quality has distinguished the Chief throughout his long life, it has been his adaptability to a world light-years removed from that of his forebears. Beginning with the disruption of his early childhood, when the throes of the Indians' final defeat by the white man were suffered in helpless indignity and an entire culture withered, Red Fox somehow survived. Moreover, un-

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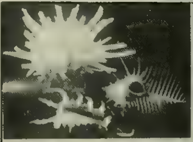

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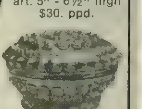

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ike most of his demoralized compatriots, he was able to become func-ional and articulate in a way of life mpossible for many of them. From Hollywood to Madison Avenue, from Dallas rodeos to Kalamazoo supermarkets, he abundantly displayed his apacity for the specialized wit it takes o thrive in the twentieth-century American Supermarket. There is a case o be made for the thesis that the Chief s a thoroughly acculturated Red Man, f ever there was one.

This is not to say that he is a mere ci-ar-store Indian. The triumph of mother wit in a culture so alien to Indian tradi-ions is no small achievement. And wherever he has gone, the Chief has brought a message and a consciousness o the crowds—a reminder of those proud ancestral ghosts and their mod-rn, destitute children whose presence e represents in terms that the public omprehends.

As a representative of the Indian in ur culture, however, his romantic im-ge contains some stark and painful nomalies. This is the image, put rudely, of the gewgaw, the circus reature who dances and powwows to urvive. Almost since their first con-acts with the white man, American In-ians have felt compelled to entertain im as a means of survival. The rela-onship of white to Indian, especially fter the violent subjugation of Indian rength and spirit, has consistently een that of audience to performer. nd this relationship has corrupted the erformer more than the audience. To itness a so-called Indian dance, such s those put on by tribes throughout the ountry every year for the passing fancy f the tourist horde, is an exercise in athos. The bangles and trinkets, dime ore costumes, and two-step charades at pass for Indian authenticity seem ore often a degeneration of some an-ent Ringling Brothers routine that ex-ted a simpler, small-town age. Quite ssibly the routine is all that's left—the irit so irreparably broken that the uel self-abuse of parody is the only re-ourse at hand for preservation of an-stral rituals in today's society. The In-an as self-huckster, as performer, i e Indian most white men know and cept. When Chief Red Fox, or an-her Indian, appears on the "Tonight ow," the band invariably erupts int chorus of absurd whoops and drum ats that confirm the circus image. In cial terms, too, it is as if the strains of Old Black Joe" were to greet Flip Wil-on or Sammy Dav

Today, Indians are not recovering an image so much as creating a new one. They are painfully aware of their picture postcard value in an American culture that manifestly considers them curios, rather than human beings. In Michigan, a group of Chippewas and Ottawas are strongly resisting state attempts to build another "typical Indian village" for the tourists. "If the state or federal governments have an extra half-million dollars to spend on Indians," says Jay Harrington, a Petoskey Ottawa, "we would prefer it used to fix up our houses, or create better jobs, or for the education of our children. In this day and age, most of us have our own plans for our lives, motivated by an ambition to create a better life for our children. I believe I speak for the majority of Indians in saying I would not want my children to dress up in Indian attire and sit around doing beadwork all day in a fake Indian setting."

During the period when Chief Red Fox was distributing recipes to housewives, I marveled that so little demand existed for the most priceless treasure he has to offer: his memory. Where were the Ph.D. researchers, the history symposia, the anthropologists, the scholars of Americana? The dismal waste of an aged national archive prancing amid the jangle of cash registers and grocery carts was somehow obscene, an affront to intellectual, if not humane, values.

Perhaps some day native Americans will no longer need to subject themselves to supermarket or gift shoppe merchandising in order to live. *The Memoirs of Chief Red Fox* may hurry this day.

JOHN EASTMAN

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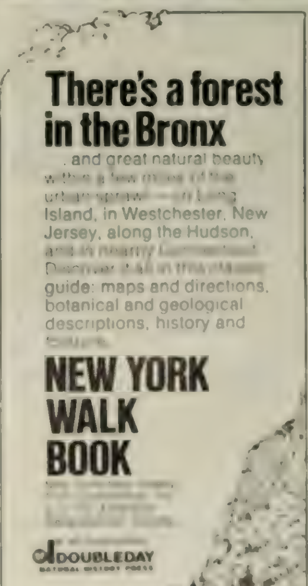
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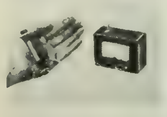

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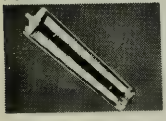

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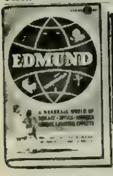

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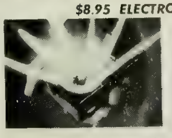
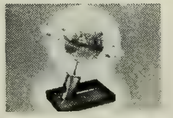


Hand-sized solid state electronic strobe light at fantastically low price. Produces bright psychedelic effects like larger, far more expensive Xenon strobes, yet it's just 2¾ x 4 x 1⅜" thick. Adjustable flash rate, approximately 3-10 flashes per seocnd. Make stop motion effects, posters come alive. Great to take with you to parties, dances, outing, etc. Requires 2 9v transistor batt. (not incl.). Instructions.

Stock No. 41,443E .... $8.95 Ppd

4 REPLACEMENT LAMPS P-41,444E .... $1.00 Ppd.

DECORATIVE "3-D" STAR CHART



Quickly, easily locate stars in your sky—anytime, anywhere. Handsome 10" high Sky and Earth Globe has fixed transparent 7" diam. outer celestial sphere with equator calibrated in months. 4" diam. inner earth sphere (in relief) revolves on inclined axis—includes long. & lat. markings. Correlate location on earth globo with current month—outer globe shows stars visible in your sky. Incl: Free Star Finder, Atlas, Instr.

Stock No. 70,984E $14.50

50-150-300 POWER MICROSCOPE

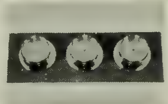
Amazing Value—3 Achromatic Objective Lenses on Revolving Turret! Color-corrected, cemented achromatic lenses in objectives give far superior results to single lenses usually found in this microscope price range. Results are worth the difference! Fine rack and pinion focusing. Imported!

Stock No. 70,008E .... $19.50 Ppd.

MOUNTED 500 POWER OBJECTIVE:
Threaded achromatic lenses, 3mm F.L.

Stock No. 30,197E .... $5.75 Ppd.

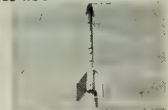
ACCURATE HOME WEATHER STATION



Handsome "Weather Station" highly sensitive to weather changes. Thermometer accurate to ± 2%; barometer to ± .025", hygrometer to ± 5%. Foretells weather changes from 12 to 24 hrs. in advance. Perfect gift—excellent for teaching weather phenomena. Mounted on wood-grained wall panel 15½" x 5¾". Meter cases heavily metalized. High-precision dials in etched aluminum. Full instructions.

Stock No. 70,607E .... $12.98 Ppd.

NEW LIQUID-FUEL ROCKET KIT



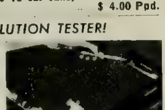
Apollo-type rocket soars to 1,000 feet at 300 ft. per second . . . then gently returns to earth on automatic parachute. Fantastically realistic lift off, flight, vapor trail. 16" aluminum rocket can be fired manually or electrically (req. 6v Batt. not incl.). Loads of fun building, decorating, launching again & again. Includ.: 16 Pg. instruct., engine, timer, separator, parachute, parachute tube, nose cone, fins, loading valve, hose, electric firing assembly, launch stand, propellant.

Stock No. 71,182E .... $15.95 Ppd.

EXTRA PROPELLANT (Two 15 oz. cans)

Stock No. P71,192E .... $ 4.00 Ppd.

$16.50 AIR POLLUTION TESTER!



1st LOW-COST survey-type instrument. Quickly provides quantitative results in threshold limit ranges set by Amer. Conf. of Gov't Industrial Hygienists. Sensitive, accurate, wide measuring range. Includes 2 ampoules each to test for CO$_2$, CO, H$_2$S, NO$_2$ and SO$_2$. Sufficient for 2 to 4 tests depending on concentration. Lightweight Kit includes sturdy vacuum pump, coupling tubes, complete instructions with scales to determine results. Sets (4) of replacement ampoules available separately for $4.75.

Stock No. 71,349E .... $16.50 Ppd.

WAR SURPLUS ELECTRIC GENERATOR

Brand new Signal Corps Electric Generator. Generates up to 90 volts by turning crank. Use in high impedance relays. Charge ground & bring up night crawlers for bait or study. 2 Alnico Magnets alone now worth more than original gov't cost of $15. Wt. 2 lbs.

Stock No 50 225E .... $8.50 Ppd.

POWER HORN BLASTS A MILE

Frighten prowlers, muggers, vicious dogs with 118 decibels. Just press and this Freon powered pocket-sized metal horn can be heard a mile away to signal for help or fun. Great for boating (it floats), hiking, camping, hunting, seashore, rooting for your team. Can be heard over traffic and constr. noises to sound fire drill, lunch break or emergency. Weighs only 3 oz. but contains up t 100 mile-piercing blasts. A real bargain.

Stock No. 41,423E .... $3.25 Pp

2 Refill Cartrs. (P-41,424E) .... $2.75 Pp

BUTTERFLY & INSECT COLL. KI

Bargain buy for the budding naturalist! Basic Butterfly & Insect Collecting and Mounting Kit has everything needed to start a butterfly or invertebrate collection. Includes 3 x 10" spreading board, 2-oz. bottle of dispatching fluid, eyedropper, relaxing fluid, wood-handled butterfly net, 2 butterfly specimens, 100 #2 insect mounting pins, 20-page illustr. booklet. Kit weighs 9-lb and is tons of educational family fun at a very low pric Terrific value!

Stock No. 71,518E .... $4.95 Pp

WOODEN SOLID PUZZLE

Fascinating assortment of 12 different puzzles. Provides hours of pleasure—stimulates ability to think and reason. Animals and geometric forms. Take apart and reassemble. Lots of fun for the whole family—young and old. Will test skill, patience and ability to solve problems.

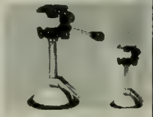
No. 70,205E ....$5.00 Ppd.

LOW-COST DOUBLE-BARRELED TUMBL

Rugged 12-lb. tumbler has TWO big 6-lb. (4½-pt.) capacity rubber barrels, each with ten internal sides—twice tumbling action of more expensive models. Quiet, resilient, dependable, safe operation. Features fan-cooled, continuous-duty 1550 rpm motor; V-belt drive w/nylon bearings; covered safety belt & pulleys. Real money-saver for sm shops, experimenters—great for rockhounds. 10½" 11½" x 12¼".

Stock No. 80,132E (18 lbs.) .... $39.95 P

VERSATILE VACUUM-BASE TRIPO



Supports large professional type cameras firmly for long-exposure photos. Powerful rubber suction cup (4⅜" dia.) w/locking lever assures adherence to any smooth surface—tables, cars, walls, glass, tile. Has universal panhead, removable pan handle and swivel control knob. Compact (stands approx. 8" high), it works with all size cameras—can also be used to firm binoculars and monoc lars. Great help to both amateurs and professiona Imported.

Stock No. 71,514E .... $14.95 P

4¼ ASTRONOMICAL TELESC

See craters on moon, rings of Saturn, double stars. Up to 270x. New vibration-free equatorial mount. f/10 mirror corrected to better than ¼ wave length. Gives theoretical limited resolution. Rack and pinion focusing. Aluminum tube, 6x finder telescope. 2 standard eyepieces and Barlow lens gives power up to 270x. Free: Star Chart, 272-page "Handb of the Heavens" plus "How to Use Your Telescope".

Stock No. 85,105E ....(Shipping wt. 42 lbs.) $94

NEW BINOCULAR-TO-CAMERA HOL

Fits any camera for exciting telephoto pictures. 35-mm camera with 7 x 50 binocular brings distant object 7 times nearer. Ideal for long-range photos of wild life, ships, people, planes, etc. Attaches easily. Use any binocular or monocular—and camera—still or movie, color or black & white. Gray crinkle and bright chrome finish. 10" long. Full directions.

Stock No. 70,223E $13.50

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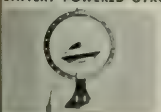
Stock No. 9391E .... $2.95 Ppd.

BATTERY POWERED GYROSCOPE

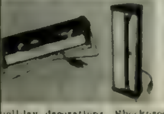


For the first time—have the fun & enjoyment of a gyro without bother of constant string winding & pulling 5" diam. flying-saucer shaped. Spins on its edge, upside-down, on your head, hanging from a string, drives rocket car, races around ring . . . you'll be amazed at its performance. Even flipping switch to off is an experience—speeds up to a blur . . . for almost 3 min. without power. Terrific accessories incl. rocket car, pedestal, 9" diam. orbit ring, ring pedestal, cap, chain, loop, instr. Operates on 2 "C" batt. (not incl.).
Stock No. 71,161E $6.00 Ppd.

MODEL DIGITAL COMPUTER

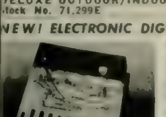
Solve problems, teach logic, play games with miniature version of giant electronic brain! Adds, subtracts, multiplies, shifts, complements, carries, memorizes. Colored plastic parts easily assembled. 12" x 3½" x 4¾". Incl step-by-step assembly diagrams. 32-p. instructions covering operations, computer programming problems & 15 experiments.
Stock No. 70,683E .... $ 5.98 Ppd.
ANALOG COMPUTER KIT
Stock No. 70,341E .... $18.95 Ppd.

BLACK-LIGHT MIGHTY MITES



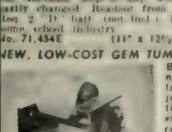
Relatively small (12") fixtures give surprisingly bright blacklight. Mirror-finished reflector makes instant starting 8-watt, high-intensity bulb look like 10 watter. Up to 5,000 hours of safe, long wave (3660A) blacklight to really turn on parties, light & theatrical shows, psychedelic decors, holiday decorations. Shockproof end-caps remove for safe, easy replacement of bulb and starter. Stands upright or horizontal. Aluminum case.
Stock No. 71,274E ......$14.95 Ppd.
DELUXE OUTDOOR/INDOOR MODEL
Stock No. 71,299E $19.95 Ppd.

NEW! ELECTRONIC DIGITAL COMPUTER KIT!



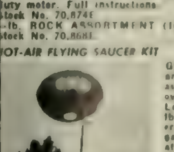
Solve problems, play games, predict weather with this actual working model of giant electronic brains. Amazing new fun way to learn all about computer programming . . . logic, decimal, binary systems, Laws of Sets—even do your own programming after completing simplified 116 page instruction book. Includes step-by-step assembly diagrams. Circuits easily changed. Readout from illuminated control panel. Req. 2 "D" batt. (not incl.). Best model we've seen for home, school, industry.
No. 71,434E (11" x 12½" x 4") $31.50 Ppd.

NEW, LOW-COST GEM TUMBLER



Become a rockhound! Fascinating hobby . . . loads of fun, inexpensive, easy. Make jewelry of all kinds—decorative book ends, table tops, etc. Simply tumble finish readily available gemstones . . . then polish to high lustre . . . brings out beautiful colors. Rugged 3 lb. capacity tumbler w/continuous duty motor. Full instructions.
Stock No. 70,874E $10.75 Ppd.
-lb. ROCK ASSORTMENT (10 TYPES)
Stock No. 70,868E $ 9.00 Ppd.

HOT-AIR FLYING SAUCER KIT



Giant 9 ft. model rises to amazing heights. Easy to assemble and launch. Use over and over. Low cost. Lots of fun. Can carry ¼ lb objects with string tether. Fly school colors at games, use for advertising, attach mirror—"play spy in the sky." Includes complete instructions, 16 pre-cut #1 white model paper gores, 8 ed panels for portholes, wire, cord. Easily repaired if amaged.
Stock No. 71,175E .... $8.00 Ppd.
FT. HOT-AIR BALLOON KIT
Stock No. 60,691E $2.00 Ppd.

See moon shots, orbits, stars, craters!

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60 to 180X

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Amazingly priced Apollo Space Explorer brings the wonders of the universe up close. 3" aluminized & overcoated f/10 mirror. Reaches theoretical limits of resolution & definition. 60X standard size 1¼" O.D. eyepiece, ½" F.L. 3X adjustable Barlow, 6X finder telescope; high impact plastic tube; metal fork mount w/ positive locking. 36" hardwood tripod. Included FREE: 272 p. Handbook, Star Chart, Instructions. Best value ever!
Stock No. 80,162E .... $59.50 Ppd.
REG. 3" REFLECTOR TELESCOPE
Stock No. 85,050E $34.50 Ppd.
4¼" ASTRONOMICAL REFLECTOR TELESCOPE
Stock No. 85,105E $94.50 F.O.B.
6" ASTRONOMICAL REFLECTOR TELESCOPE
Stock No. 85,086E .. .. $239.50 F.O.B.

GIANT WEATHER BALLOONS

"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great backyard fun. Exciting beach attraction. Amateur meteorologists use to measure cloud heights, wind speed and temp. Made of heavy duty neoprene. Inflate with vacuum cleaner, auto air hose; or helium for high rise.
Stock No. 60,568E 8' $2.00 Ppd.
Stock No. 60,632E ....16' .... $7.00 Ppd.

TURN BOTTLES INTO TREASURES

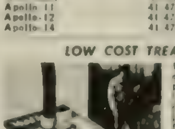
Easy-to-use Bottle Cutter Kit lets you be ecological and artistic. Make saleable, attractive glasses, lamps, dishes, candle-holders, vases from ordinary no-return smooth-surface bottles or jars! Cut any round bottle safely, easily in less than 5 minutes for fun, profit, home decorations with just an ice cube and this kit. Includes: cutter (3¼ X 7½ X 2½"), candle, 2-oz grinding powder. Complete instructions.
Stock No. 71,475E $10.95 Ppd.

SUPER 8 APOLLO MISSIONS FILMS

Relive history in your home with 400 Spectacular feet of Official NASA Super 8 full color or b & w films of the Apollo shots—from breathtaking blast-off to touchdown. See Neil Armstrong's 1st step, Apollo 13's return, [illegible] Shepard's [illegible] exploring of Fra Mauro. Fabulous entertainment. Future heirloom. Color $11 [illegible] ea. B&W [illegible] ea. All Ppd.

Moon shot	Color #	B&W #
Apollo 11	41,475E	41,471E
Apollo-12	41,477E	41,476E
Apollo-14	41,479E	41,478E

LOW COST TREASURE FINDER



Discover the fun and profit of treasure hunting inexpensively. Light as a feather (10 oz.) solid-state metal detector finds hidden coins, jewelry, precious minerals. Distinguishes minerals from metal objects. Great for school, beach, campground or backyard. Requires 9V transistor batt.—works with any common AM transistor radio, thus eliminating costly extra circuitry, weight, dangling wires. Adjustable multi-purpose plastic handle [illegible] immediate area metal—adds to efficiency. No tuning needed.
Stock No. 71,395E $14.95 Ppd.

TERRIBLE LIZARDS, MONSTROUS MAMMALS

Explore the fascinating prehistoric world of dinosaurs 200,000,000 years ago. New kit contains 24 authentic scale models (12 dinosaurs—12 mammals) accurately detailed in sturdy plastic. Incl. Giant Brontosaurus, fierce Tyrannosaurus, Woolly Mammoth—range in size from 2" to 6". Also [illegible] to build your own [illegible] land and [illegible] flora.
Stock No. 70,[illegible] $[illegible] Ppd.

"FISH WITH A MAGNET

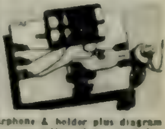
Go treasure hunting on the bottom! Fascinating fun & sometimes profitable! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Troll it along bottom—your "treasure" haul can be outboard motors, anchors, etc. 5-lb. Magnet is war surplus—Alnico-V Type—Gov't cost $50. Lifts over 150 lbs. on land—much more under water.

Stock No. 70,571E	5 lbs.	$14.00 Ppd.
Stock No. 70,570E	3½ lbs.	$ 8.75 Ppd.
Stock No. 85,152E	15¾ lbs.	$33.95 FOB

HELIUM BALLOONS MAKE A "BALL"

Anytime there's a balloon the air is festive. Especially when the "air" is helium, which makes a balloon perky and adventurous. Now here's 25 times the fun—25 balloons of 4, 5, or 6" diam. With them, a pressurized (300 lbs/sq. in.) can containing 25 liters of helium to inflate all 25. Helium is a safe non-toxic inert gas.
Stock No. 71,289E $3.00 Ppd.

BUILD A WORKING CRYSTAL RADIO



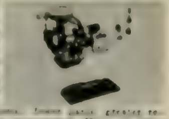
Bring the 20's back with the fun of a modernized earphone crystal set that receives 1 or more stations! So simple you can have it working in less than an hour. Connects to a permanently fixed germanium crystal. Kit incls: 4¾ X 6¾ X ½" thick plywood base, high-Q tuning coil, germanium diode, variable condenser, all radio parts, earphone & holder plus diagram & simple instrs. A charming conversation piece, great fun at parties and ideal gift.
Stock No. 71,513E $5.95 Ppd.

VERSATILE WHITE MODELING PLASTIC

Perfect for figures, forms, shapes, product & tool designs, negative molds, model making, etc. Easily shaped by hand, tools. Can be rolled flat, built up into figures. Permanently pliable until baked at 300° F for 15-30 minutes in oven—no kiln nor plaster molds needed. Requires no curing. Won't shrink. Acquires permanent, non brittle hardness when shaped & baked. Can then be cut, sawed, drilled, sanded, painted, embossed. Smooth, non-sticky, harmless.

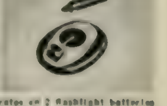
Stock No. 60,794E	2 lb	$ 3.60 Ppd.
Stock No. 71,205E	8 lb	$10.50 Ppd.

AMAZING NEW WANKEL ENGINE KIT!



Thrill to the fun of [illegible] your own see-through motorized model of revolutionary rotary [illegible] type engine. [illegible] engine experts think [illegible] feasible to meet new pollution standards. Replaces piston, cylinder, crank assemblies with [illegible] for firing [illegible]. Smaller than [illegible], fewer parts, greater reliability, same speed [illegible]. [illegible] plugs, rubber fan belt, [illegible] switch. Req. 2 "D" batt. (not incl.).
No. 71,424E (4½" x 5" x 8") $8.75 Ppd.

CAR OF THE FUTURE HERE NOW!



One of most impressive science toys we've seen. Low-flying air car rides a fraction of an inch over any surface, including water. Graphically demonstrates same principles that apply to Ford's and Curtiss-Wright's new wheelless air cars. Sturdy red and yellow plastic 8" wide, 9" deep, 3" high with 4" propeller. Operates on 2 flashlight batteries (not incl.). 45" control line, battery case.
Stock No. 70,907E $3.50 Ppd.

ECONOMICAL WATER LEVEL ALARM

Avoid costly internal flood damage with this ultra-sensitive solid-state electronic device. The second it detects unwanted water it sounds off with a loud buzzer alarm to [illegible] of dollars of [illegible] of a [illegible]. Plugs into any 110-120V AC outlet. [illegible] transformer generates low voltage for complete safety. Consists of Metal Finger Unit and Sensor [illegible].
Stock No. 41,[illegible] $[illegible] Ppd.
[illegible] $[illegible] Ppd.

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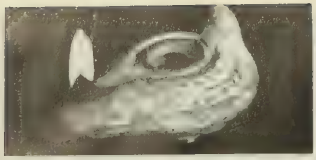

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Suggested Additional Reading

THE ELUSIVE SERINGO

Birds and Men. R.H. Welker. Atheneum Publishers, New York, 1966.

The Journal of Henry David Thoreau. B. Torrey and F.H. Allen, eds. Dover Publications, Inc., New York, 1906.

IMMORTALITY AND THE FREEZING OF HUMAN BODIES

The Prospect of Immortality. R. C. Ettinger. Doubleday & Company, Inc., Garden City, 1964.

Physics and Life Prolongation. G. Feinberg. *Physics Today*, November, 1966.

A PORTRAIT OF TINKERS

The Honey Spike. B. MacMahon. The Bodley Head, London, 1967.

Report of the Commission on Itinerancy. The Stationery Office, Dublin, 1963.

NAKED GILLS AND RECYCLED STINGS

The Lower Animals. R. Buchsbaum and L. Milne. Doubleday & Company, Inc., Garden City, 1960.

American Seashells. R.T. Abbott. Van Nostrand Reinhold Company, New York, 1954.

American Opisthobranch Mollusks. E. Marcus and E. Marcus. Univ. of Miami Press, Coral Gables, 1968.

FLY IN THE SUNDEW

Insectivorous Plants. C. Darwin. AMS Press, Inc., New York, 1893.

The Carnivorous Plants. F.E. Lloyd. The Ronald Press Company, New York, 1942.

THE MELANCHOLY ADDICTION OF OL' KING COTTON

The Unforeseen International Ecologic Boomerang. M.T. Farvar and J.P. Milton, eds. *Natural History Magazine*, February, 1969.

The Careless Technology: Ecology and International Development. M.T. Farvar and J.P. Milton, eds. Natural History Press, New York, in press.

Pest Control. W.W. Kilgore and R.L. Doutt, eds. Academic Press Inc., New York, 1967.

Biological Control. C.B. Huffaker. Plenum Publishing Corporation, New York, 1971.

AN INVASION OF SHARKS

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Some down-to-earth reasons for buying an Olds Ninety-Eight:

1 Many of the "extras" you want are standard on Ninety-Eight. Automatic transmission, for example. Power steering. And power front disc brakes. On Ninety-Eight Luxury models, a two-way power front seat is standard. And power side windows.

2 The Ninety-Eight is a big car. And that's a very practical consideration if you happen to have a big family. Or if you like to take driving vacations. Or weekend trips to the lake. The Ninety-Eight seats six—not elbow to elbow—but comfortably, with room to stretch out. And you can pack your golf clubs, outboard motor, beach gear and luggage into the generous 20.8-cubic-foot trunk.

3 Ninety-Eight is a superb road car. Olds' exclusive ride system incorporates a combination of engineering advances in chassis, suspension and steering. You negotiate scrubboard roads, chuckholes, hairpin curves and smooth interstate highways with ease.

4 Ninety-Eight's front bumper is exactly what the name implies. A bumper. It's built of heavy-gauge plated steel – and mounted on new spring-steel supports that flex to help absorb minor impacts, then return to position.

5 The Ninety-Eight engine is a 455-cubic-inch Rocket V-8. While it's so soft-spoken you hardly know it's there, you have all the reserve you could ever want. And it runs just fine on no-lead, low-lead or regular gas.

6 Surely security is an important reason for considering an Olds Ninety-Eight. The very fact that it's big – over 4,500 pounds – makes you feel secure. But there's more. In the doors beside you are tough side guard beams. Over you is a reinforced double-steel roof. In front of you is an energy-absorbing steering column. And all around you are other GM safety features.

7 Ninety-Eight is loaded with little niceties that make traveling by auto more than just transportation. Extremely efficient soundproofing helps keep outside noises out. The front seats are six inches of solid foam—not a thin layer of padding on ordinary springs. Fine fabrics and plush carpeting surround you. The outside mirror is remote-controlled. Luxury models have front and rear cigarette lighters, an armrest in the center of the rear seat, even a clock exclusively for the convenience of rear-seat sedan passengers.

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